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# MULTITUBULAR BOILER.

J. BROWN. St PETERSBURG

ENGINEER



Fig 1

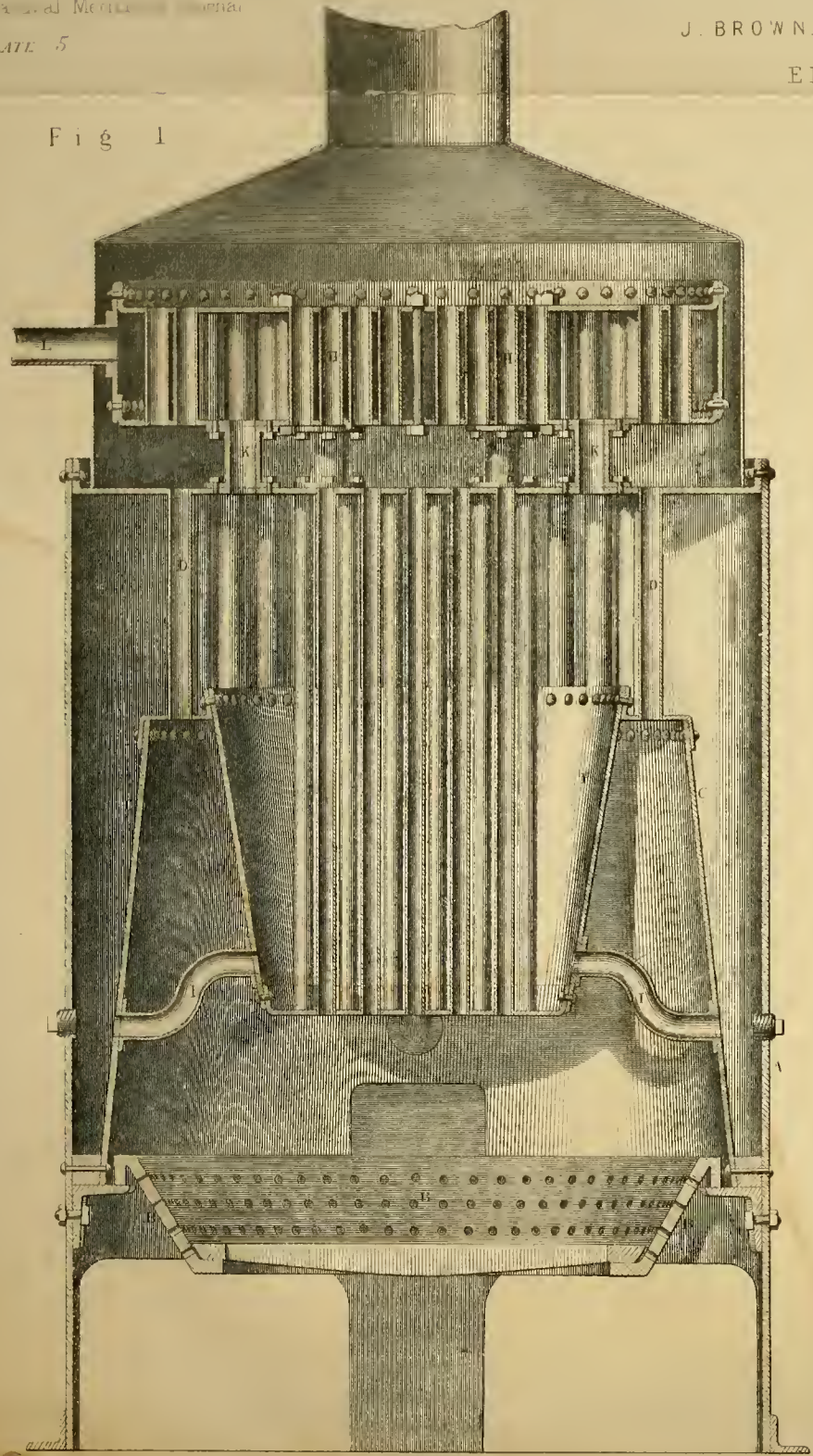


Fig 2.

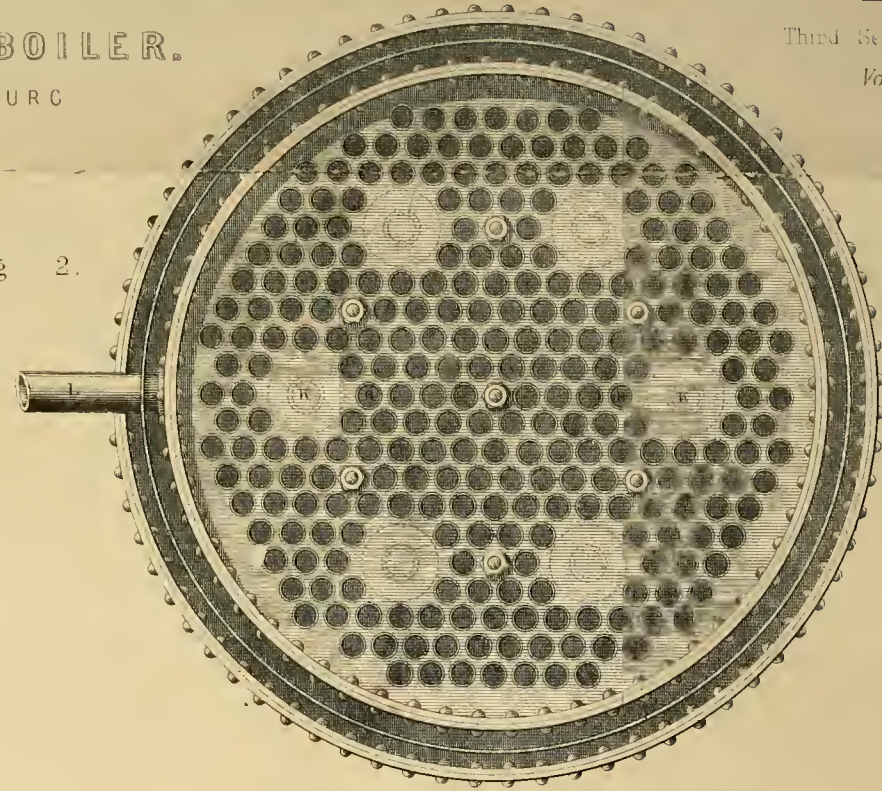
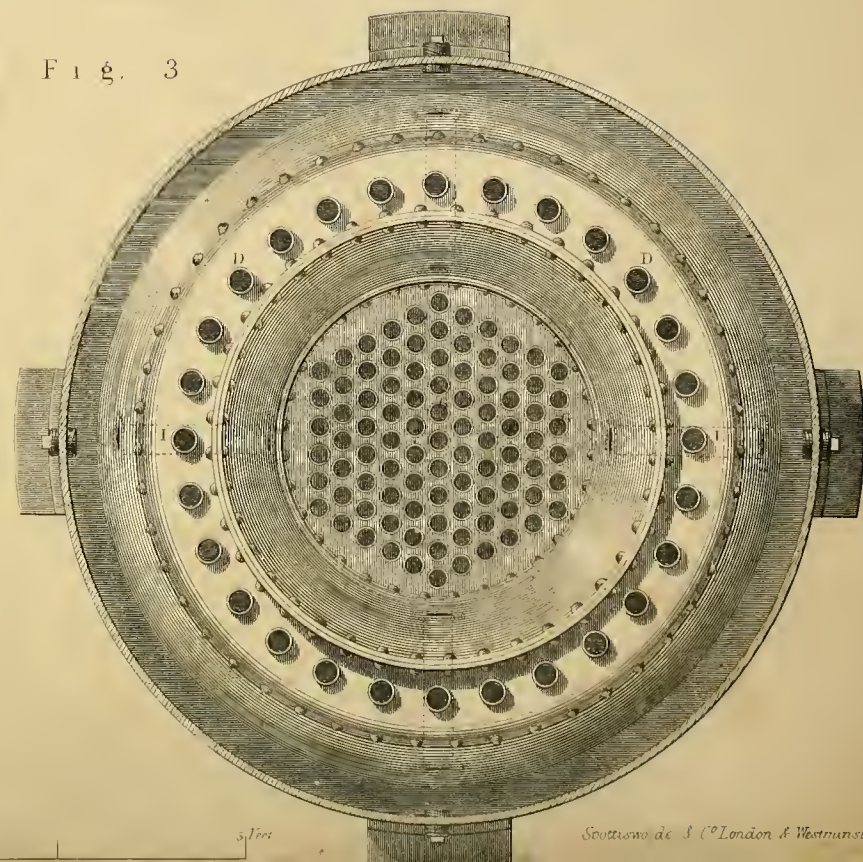


Fig. 3



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THE

# PRACTICAL MECHANIC'S JOURNAL.

## RECENT MODIFICATIONS AND IMPROVEMENTS OF SUGAR-MAKING AND REFINING.

While the sugar-refiners' manufacture in London is, as is said, and we fear but too truly, going headlong to the dogs—through unwise, unequal, and oppressive legislation, if the refiners' own account of it is to be accepted—unceasing energy, and the continual application of the highest resources of science and engineering skill, are evident upon the Continent, and indeed are not wanting in the more favoured sugar districts of our own country.

Bristol once had, if not a monopoly, at least the lion's share of the sugar-refining trade of Great Britain. London and Glasgow divided the empire of sugar with her; and now the same causes which it is said mainly contributed to the transfer of the Bristol sugar industry elsewhere (chiefly cheaper fuel and wages) seem likely, along with the pressure of unequally laid-on duties, to divert the London trade also to the Continent and to Glasgow.

Very large importations of refined sugar now come from Belgium, which the London refiners affirm only gain a footing by reason of the unjust and inequable way in which the sugar duties—rated upon a false basis—are levied, and by which the advantage is given to the foreigners without any corresponding advantage to the British consumer.

It is not for us here, however, to enter at any length upon the fiscal relations of sugar-refining. Amongst the many curious phenomena as to recession or progress which the British trade presents, we may, however, notice this: that whereas, nearly one hundred years ago, Dublin possessed a considerable sugar-baking trade, which dwindled and died out soon after the effects of the Act of Union in the first years of this century were felt and had long ceased to exist, at present one very large and complete sugar refinery has, within the last four or five years, been created by a few of the most intelligent capitalists and merchants of Dublin, and is believed to be at present in full work.

*Very* cheap coal cannot at Dublin alone support the sugar refiner, who, one must suppose, is exposed to every disadvantage of the English refiner, as well as to others peculiar to his locality.

At the same time, the manufacture of beet-root sugar, tried some years ago in Ireland, and with completely disastrous results, is being urged through the press for trial again in England. The persistence, with which correspondence &c. upon this subject is kept up in the pages of some leading papers, suggests that there are "wire-pullers" behind this "industrial movement," and that the statements put forward demand caution before being taken for more than interested communications in disguise.

Nothing is easier than to get chemical evidence to sustain almost anything, if those who want it only have craft enough to get, from a really truthful and honourable chemist, experimental answers to questions, the purpose and drift of which are kept in the dark. Beet-root, for example, may afford rich sugar products to the chemical analyst, but it may be anything but a genuine or fair sample of such beet-root as our English soil and climate, &c. will on the average afford.

This much as to the beet-root sugar experiment in Ireland we can say, as a result of having had some tolerably exact and personal acquaintance with its circumstances and working, viz. that its failure did not arise wholly, if at all, from the social causes so speciously put forward then and since by its first promoters, and that it did fail no doubt in part through ignorant mismanagement, and the general absence of technical knowledge in Ireland, but also and mainly because neither the climate nor the conditions of land tenure and of agriculture in that country were suited to the beet cultivation, and to its steady supply; and that the beet-root, when obtained, was much below the average in percentage of real crystallizable sugar of that produced under the drier and sunnier summer skies of the central plains of Germany, of Belgium, and of France. Upon this point we are quite aware that highly conflicting evidence may be, and has been, brought forward. It would require a vast deal of very carefully-examined evidence from the laboratory, however, to shake the truth of the general fact that all roots and other parts of vegetables which contain more or less sugar tend to produce more of other types of hydro-carbon (pectine, lignin, &c.) and less of true sugar, as they grow in places more sunless and moist.

We apprehend, too, that a careful investigation as to the differences in circumstances of the land in England and abroad—the burdens on it, the condition of our other high and forced agriculture to that of mere root crops which cannot merely intercalate themselves amongst existing English rotations—would prove that there are greater difficulties (to say the least) in the way of beet-root sugar manufacture than its recent advocates in the public press have admitted. The beet-root sugar industry of the Continent is undoubtedly one of the most brilliant chapters in the history of industrial progress, and will ever reflect honour upon the sagacity of Chaptal and the chemists of the early days of the First Empire, upon the zealous encouragement of Napoleon I., however mistaken was the political-economic theory upon which—or rather, for the sake of his tyrannous grasp of military power—he espoused it; the highest credit of all belonging to that long train of men, chemists.

Industrial leaders, capitalists, engineers, manufacturers, physicists, have during more than half a century steadily pressed one improvement, one refinement after another into this great manufacture, until of late years the boast of Napoleon I. has practically been realised, and France, Belgium, and Germany are able to say that, were they obliged, they could now do wholly without colonially-supplied sugar. But we must bear in mind that not only the early cradle of beet-root sugar was rocked in Europe by favouring and exceptional circumstances and Customs legislation, but that, until the advent of railways on the Continent, it possessed *per force* the serious advantage of the saving of a tedious and costly inland carriage, as against all sea-borne sugar. Even now, with all its development, and every perfection that science has brought to it, were the sugar-producing powers of our own great Indian possessions and docile people developed with anything like corresponding skill, energy, and capital, we would back East Indian cane sugar still against all Europe and beet-root at least, perhaps even against all the world.

Ninety-nine people out of one hundred, probably, who take a spoonful of "moist brown" or a dainty lump of "white" from the sugar-basin, fancy there is but one sort of sugar known to the vegetable world; that white is but brown more refined, as the white man is a man and a brother, perhaps, but clearly a refined sample, of the brown or black one. One of the great difficulties which have always and still beset sugar-making and refining, however, consists in the fact that the vegetable kingdom furnishes a considerable number of different sugars, mixed more or less, some with each other, all with organic compounds, and most of them of extremely ready fermentability.

There are known to chemists the following, and the list might be much extended were we to add sugars whose composition has not been ascertained with precision :—

| Name. | Composition. | Source. | Physical State. |
|---|---|---|---|
| Cane Sugar | $C_{12}H_{11}O_{11}$ | Sugar cane. | Crystalline. |
| Inverted Cane Sugar (*sucré interverté*) | $C_{12}H_{12}O_{12}$ | Same. | Not crystalline. |
| Grape Sugar | $C_{12}H_{12}O_{12}+2HO$ | Dried fruits, &c. | Crystalline. |
| Milk Sugar | $C_{24}H_{19}O_{19}+5HO$ | Whey of milk. | Crystalline. |
| Turkish Manna Sugar | $C_{12}H_{11}O_{11}+2HO$ | .. .. | Crystalline. |
| Mycoxe | $C_{12}H_{11}O_{11}+2HO$ | Ergot of Rye. | Crystalline in different form from last. |
| Melizitone | $C_{12}H_{11}O_{11}+xHO$ | *Larch* manna. | Crystalline. |
| Melitose | $C_{24}H_{24}O_{24}+4HO$ | *Eucalyptus.* | Crystalline. |
| Eucalyn | $C_{12}H_{12}O_{12}+2HO$ | ,, fermented. | Not crystallisable. |
| Sorbine' | $C_{12}H_{12}O_{12}$ | Mountain Ash. | Crystalline. |
| Mosine | $C_{12}H_{12}O_{12}+4HO$ | Animal muscle. | Crystalline. |
| Mannito | $C_{12}H_{14}O_{12}$ | *Fraxinus ornus.* | Crystalline. |
| Lichen Sugar | $C_{14}H_{16}O_{12}$ | *Rocella* and other *Lichens.* | Crystalline. |
| Oak Sugar | $C_{12}H_{12}O_{10}$ | Acorns. | Crystalline. |
| Pinito | Same. | Pinus Lambertiana. | Crystalline. |

All these which crystallise assume different crystalline forms; all are more or less altered by mere boiling in aqueous solution, some lose by that their whole previous power of crystallisation; and all are altered still more by fermentation, even of a very slight character, when in contact with other organic bodies. Most if not all, too, form singular and to the refiner often intractable compounds with inorganic salts, such as those of lead and of lime. This last is the reason why some natural waters are so much better for the refiner than others.

Upon the organs of taste the effects of these different sugars vary greatly: sugar of milk, for example, is but *sweetish*. Three times as much by weight mixed with water or tea, for example, hardly gives the sweetness of one part of cane sugar. The same, but in a much less degree, is true of beet-root sugar, which is deficient in sweetness, and hence less cheap in reality than its price per pound seems to indicate.

Cheap sugar is one of the clap-traps of politicians in place in England just now. Wonderful as is the low price of cane sugar now as compared with what it was in 1815, it is less to legislation than to improvement in manufacture that we must look for having it still cheaper.

The fact is, the waste of good sugar begins from the moment the knife is applied to the ripe sugar-cane to cut it down. The long-used and established process for the extraction of the juice is by cutting the cane into short lengths and passing these between the rollers of the sugar mill; but though the cane in 100 tons contains about 90 tons of juice, only about 75 tons are usually squeezed out, and in the West India Islands and Cuba, it is said, not 60 tons. The juice is pumped up from the trough into which it falls from the roller, with every precaution so far taken to avoid agitation and mixing with air by the pumping; in the tropical climate of the sugar regions fermentation sets in within an hour or so of the expression of the juice. To check this, which, if let go on, would produce alcohol, and vinegar at last, more or less lime is added: this produces at once a loss, though not a large one, of sugar.

The boiling of the juice succeeds; the fuel being the "cane trash," as the crushed cane pieces, holding still a large percentage of sugar, are called, and their ashes being returned as the fit inorganic manure to the plantations.

The boiling pans or "teaches," holding from 300 to 500 gallons or more, should not be heated to more than about 140° Fahr., but in negro hands this is not preserved, and so a large proportion, and an ever varying one, is converted into uncrystallisable sugar, and finally goes to molasses and to the rum still. The "teache" has to be skimmed to remove the albuminous portion of the juice of the cane; here more waste arises, and so on at every step, until the drained brown sugar crystals are dried in the sun and "casked."

The waste is not over; even on the voyage to Europe, as the owners of iron sugar-ships know to their cost, the droppings or drippings from the sugar hogsheads or bags producing a weak syrup with the bilge water, if any, which becomes converted partly into acetic acid and acts rapidly upon the iron plates of the ship.

The crude canes as cut have the following composition as given by Peligot and by Dupuy, for Martinique and Guadaloupe growths respectively :—

| | Martinique. | Guadaloupe. |
|---|---|---|
| Water | 72·1 | 72·0 |
| Sugar | 18·0 | 17·8 |
| Tissue, or fibre | 9·9 | 9·8 |
| Ashes, or inorganic salts | | 0·4 |
| | 100 | 100 |

And the scum taken from the "teache" after liming has, according to Payen, the following constitution; this, however, must vary between limits :—

| *Sugar Scum.* | |
|---|---|
| Cerosine (sugar-cane wax) | 7·15 |
| Chlorophyle (green colouring matter) | 1·50 |
| Albumen, and traces of cellulose | 5·56 |
| Phosphates of lime and magnesia | 15·70 |
| Carbonate of lime | 2·30 |
| Silica (from the epidermis of the cane) | 6·15 |
| Oxides of iron and manganese—traces | |
| Water | 61·64 |
| | 100 |

The French West Indian sugar planters do not so much employ the old form of hemispherical "teache" long made for our islands as the form of communicating rectangular pans heated by open fire, but so "set" as to have the temperature under good control, known in France as the "*Batterie Gimart.*"

These naked fire pans gradually acquire a hard incrustation on their interiors, which sometimes requires the empty pans to be heated strongly in order to split it off. The composition of this curious material has been found by M. Aquevin to be, in copper pans :

| | |
|---|---|
| Phosphate of lime | 92·43 |
| Phosphate of copper | 1·41 |
| Carbonate of lime | 1·35 |
| Silica | 4·71 |
| | 99·90 |

When the pans are of cast iron the phosphate of copper is replaced by phosphate of iron.

The final evaporation, prior to crystallisation, is almost everywhere now performed in pans heated by steam.

Messrs. Pontifex and others are amongst our great coppersmiths who, in England, manufacture the train of sugar apparatus. In France there are several makers, amongst whom MM. Brissonneau Frères of Nantes hold a distinguished place. A magnificent display of a complete sugar-making establishment was exhibited by them at the Great Exhibition of 1867.

Plates of all the apparatus of sugar, including the centrifugal drying machines and other arrangements special to that and to other French houses, will be found in M. Armengand's *Publication industrielle*, in various volumes, and specially in Vol. 14.

The oldest sugar mills consisted of three huge rollers of solid timber—native West Indian hard wood, with their axes vertical; these were geared together at the top ends, set in huge wooden framing, and driven by oxen. These gave place to the horizontal cast-iron rollers in cast-iron framing, constructed, we believe, first in England by the founder of the firm of Faucett, Preston, and Co., Liverpool, and about the same time in Bristol and by Rennie in London.

Many slight modifications and improvements have since been made, but the main features remain unchanged. There are at present two or three important works in English upon sugar-mill construction, one reviewed some time ago in this journal.

A notable change has been made in the form of this machine for its special adaptation to beet-root sugar, very recently by M. Champonnais, of which we may quote the following brief notice by M. Payen.

It is difficult to see any good reason why the principle of M. Champonnais' beet-root pulp mill might not be advantageously applied to sugar-cane crushing also; for unquestionably the aim of first importance is as rapidly, and with as little "churning" as possible, to separate the whole of the juice from every particle of solid or extraneous matter. The only mechanical difficulty that suggests itself is that of the great strength necessary to be given to cane-mill rolls; this, however, might be provided for.

Note by M. Payen on the cylinder press of M. Champonnais:—

"Without entering upon detail of construction or upon the exact appreciation of the useful effects mechanically realised by this machine, I confine myself to the statement of the principles upon which its efficacious action, which produces an actual return of nearly 80 per cent. of the juice from the beet-root, is based.

"It consists in two permeable or perforated cylinders, between which the pulp is placed after it has been drained in a centrifugal machine. The superficies of these cylinders are formed by a narrow brass bar of a trapezoidal section rolled up into a spiral upon strong ribs, which are fixed parallel to the axis of the cylinder; these small bars, with the side which is the largest towards the outside, and which are spaced regularly at distances of 0·0001 m., keep back the pulp and yet allow the juice easily to penetrate into the interior of the cylinders. The juice, which runs out of the interior of each of the two cylinders, is immediately abstracted from contact with the pulp, the latter being continually scoured off by two tangential blades applying to the cylindrical surfaces. The two cylinders are inclined to the horizon, the axes of both being in the same vertical plane, so that thus the juice runs off at once by means of a gutter into the separator, and from thence into the receptor, afterwards to the evaporators; subsequent operations are effected, as usual, according to the processes and apparatus of Périer, Possoz, and Cail, &c."

A vast change will come over the primary processes of sugar manufacture, which may, probably, ultimately extend to that from beet-root, should the ingenious and promising invention of M. Jules Robert be found worthy of extended adoption. This consists in simply cutting the canes by machinery or by hand into short lengths, splitting each axially, and throwing them into water kept at a temperature under the boiling point. Diffusion (from which the process takes its name *Procédé diffusion*) rapidly takes place, and the cane gives up almost the whole of its sugar to the water, leaving nothing but a water-soaked set of cells and fibres in place.

Agitation of the juice in contact with air is to be avoided, and many of the impurities which now contaminate the expressed juice are avoided, and economy of power and of labour are thus effected.

The split pieces of cane are, we believe, subjected to pressure in order to extract the last portions of saccharine matter, and treated apart.

The process is already in use on the large scale in our Indian possessions. In January of this year (1869) we find that on the 22nd of that month "2,651 bags of sugar produced by the new 'diffusion' process of M. Jules Robert at the Aska Sugar Works (Madras Presidency) were sold in Mincing Lane for account of Messrs. Baring Brothers & Co. This was part of last season's produce of the Aska Works, and is the first considerable shipment of 'diffusion sugar' that has been sold in the European market. The 'diffusion' sugar is produced from cane without the application of the sugar mill. The cane is cut into thin ribands or slices, and the saccharine contents of its cells are extracted by bringing the slices into contact with water at an elevated temperature. The water extracts only the soluble substances contained in the juice of the plant, while most of the impurities (which in the ordinary process pass into the juice, and must be subsequently removed at great expense) are left in the unbroken cells of the cane and do not contaminate the juice. By the diffusion process, it is said, the extraction can be carried so far that 95 per cent. of all the sugar contained in the cane is passed into the clarifier, while the best roller mills at present in use do not extract more than 75 per cent. of the sugar contained in the cane, and the average of West Indian practice is an extraction of less than 60 per cent. From this it would appear that the diffusion process, besides improving the quality of the raw sugar, is capable of yielding about 50 per cent. more sugar from a given quantity of cane than the sugar mills yield at present, and the invention is therefore attracting general attention in the trade."

The scientific principle of this process really reposes upon the discoveries as to osmosis and dyalisis made by M. Dutrochet and by Professor Graham, and it is a brilliant example of the pregnant practical results that a purely abstract physical investigation may contain.

A notice was given at the very end of last year, in some foreign journals, of a singular modification of sugar manufacture, which, though not new in principle, appears to some extent so in practice. It is probably far more applicable to the beet-root sugar industry than to that of the sugar cane.

Messrs. Émile Rousseau and Bonnaterve have addressed the following notice to the editor of the *Journal des Fabricants de Sucre*, a special French journal for sugar manufacturers, from which the method will be gathered:—

"We have pursued for several years, to its full extent, a new system of extracting sugar, based upon uniting the interests of agriculture with those of the manufacture. This system rests upon the production of a compound of lime and sugar, solid, unalterable, convenient both for preservation and for transportation, &c.; in fact, a product which unites and transfers under a simple form all the yield in sugar of any saccharíferous juice. The obtaining of this product is easy and not expensive; it offers to the agriculturist the advantage of treating on the spot the pulp and salts of the beet-root which he grows, whilst it on the other hand withdraws from these the whole of the sugar, and to the manufacturer it offers a continued and certain supply of raw material, which can thus be drawn by him from any country or source. We have the pleasure to inform you that special works for the production of saccharate of lime from the beet-root have been established this year by M. N. Delajus, at Pont de Douai, near Douai (depart. Du Nord), whose works are now in full activity. They are open to all visitors who are interested in this new industry, and after the 10th of January, 1869, one of us will be permanently there in order to give any information which may be wanted.

"In the course of January we expect to be in a position to ask you the favour to inform your readers that besides the saccharate from beet-root for the extraction of the sugar, MM. Clerc and Urban, in their works at Frais Mavais, will also manufacture about 60,000 kilogrammes of this saccarate, which has been made in portions by several inhabitants, sugar planters of Guadaloupe, and the largest portion of which has been produced at the expense of the State in the government works of Saint-Jacques, at Martinique.

"Everyone will thus be enabled to judge for himself of the expediency and the advantage of this system, without being ruled by preconceived ideas or hypotheses."

We must not either omit to notice the new method of sugar making and refining of Mr. Frederick Marguerite, which consists in the treatment of the crude syrup by tribasic acetate of lead (a method which Dr. Scoffern failed in making practically useful), and separating the lead by sulphuretted hydrogen, and then in treating the syrups with alcohol and diluted sulphuric acid, from which the pure crystals rapidly form. We shall probably return to this process in a more extended notice, and for the present must refer our readers to the above-quoted and to other French industrial journals. In concluding the present paper, we may not unfitly notice a curious example both of the extent and of the resources of the beet-root and sugar manufactures abroad.

It is announced that M. Ernest Baroche will establish for the coming sugar-making season an extensive work for the extraction of juice and for the subterranean transport from thence in pipes of the juices to his manufactory at Saint-Leu d'Esserent. Two other works will be then established, so as to admit of the employment of the juice from 50 millions kilos. of beet-root at Saint-Leu. The first will be constructed upon the beautiful table-land of Neuilly-en-Thelle, 12 kilomètres from the refinery works. As water is scarce on this table-land, a pump will in the summer-time convey

the water of the river Oise up to it, not only for filling the tanks which will contain the water required for the grating of the beet-root, but also for supplying several villages inhabited by work-people, &c.

We shall conclude with the following statistics of the results of the beet-root sugar industry of France for the year 1867–68 :—

Manufactured up to the 31st of October, 1868, 77,820,793 kilos. against 54,319,290 kilos. in 1867 ; being an increase of 23,319,290 kilos.

The increase for each department is as follows : Aisne, 5½ millions ; Nord, 10½ ; Oise, 2 ; Pas-de-Calais, 2 ; Somme, 1½ ; all other departments, 3 millions.

Manufactories in activity, 453 ; against 438 in 1867. Sugar finished in the manufactory where made, 13,657,263 kilos. against 16,591,715 kilos.

The production for October, which is 68 millions, has never been so high ; that of the last year was only 52 millions ; that of 1866, 43½ ; and that of 1865, 56½ millions.—Ed.

## ANALYSIS OF THE REPORT ON SUPERIOR SCIENTIFIC EDUCATION PRESENTED TO THE EMPEROR OF THE FRENCH BY THE MINISTER OF PUBLIC INSTRUCTION.

Not only have primary, secondary, and special or technical education been long and fully understood and acted upon in France, but, in common with the Government of Prussia, that of France now fully comprehends that the very highest class of education of all—that which the man of science gives to himself and to mankind as he pursues the path of discovery—needs the encouragement and support of special national institutions, and of means and apparatus supplied at the public charge.

This report, officially published in the *Moniteur* of the 15th and 16th of November, 1868, begins by stating that the general system of public instruction in France, as organised at the present time, comprehends primary, special, secondary, and superior instruction; it is to the latter that the present report is devoted. There are, in fact, two classes amongst the men of science and men of letters—those who are competent to make "discoveries in the sciences, and to write books of lasting value, and others who endeavour to popularise the discoveries and chief works of the former class." It is true, the report says, that the same man unites often with the genius of discovery the talent of lecturing. This combination of different qualities is the happy exception which makes the professor, the literary man, and the man of science great ; but these exceptions are those which should be encouraged the most, for it is especially through such men that the status of the civilisation of a country is shown and by which it is elevated. When the Emperor therefore signed the decree of the 31st of July, 1868, he proposed giving to science, by the law of the Imperial Administratif Act, new means for study. The results of these decrees, as they have become law in France, may be given here in a few words. By the establishment of laboratories of *instruction* for the "candidates for degrees" the system of studying will be much improved ; by the establishment of laboratories of *research*, the discoverers in science will have a greater number of instruments suitable for their examinations and researches ; and through the establishment of the *École des hautes études*, they will have assiduous pupils, intelligent assistants, and future rivals and successors. In order to admit the numerous candidates already inscribed for these schools, and amongst whom are to be found men already known by their works, thirty-four laboratories will at once be founded, and courses of lectures will soon be opened at the *Sorbonne* for botanical and animal physiology, mineralogy, geology, chemistry ; at the *Collége de France* for mineralogical chemistry, organic chemistry, and anatomical physiology ; at the *Muséum* (*Jardin des Plantes*) for botany, agricultural chemistry, and zoological physiology ; at the *École normale* for physiological chemistry ; at the *Faculté de medécine* for medical botany, with a garden for experiments. This school offers to its more intelligent pupils laboratories for the most varied researches ; and the administration of the public relief of the sick and poor assist their resources on its part, by classifying in all hospitals the subjects of disease or *post-mortem*, which are of especial pathological importance for microscopic examination. The decrees of the 31st of July are thus in a fair way of execution, and these new schools are now constituted.

The section of natural sciences, which began its work, first, by preparing laboratories for the zoologist and botanist, is ready to open them also to the agriculturist.

The Minister here indicates all that which has been done for assisting the progress of agricultural science in the schools of every kind and degree, and he points with especial gratification to the establishment of model agricultural stations in different localities, such as those which render important services in Germany. He thinks, however, that all these efforts ought to be completed and realised by the organisation of a system of superior instruction which should be for agronomy that which the *École polytechnique* has been for public works, &c. "If the State," the Minister adds, "would create at various points schools of a character worthy of France, it would require a very numerous staff, extensive material, vast buildings, and expensive appliances. The Department of Public Instruction, however, is prepared to establish one, and without serious expense. The Museum (*Jardin des Plantes*) offers all the desired resources, and the land which the establishment possesses at the Bois de Vincennes is large enough, so that it is possible to establish close to a laboratory for agricultural researches such a school for theoretical and practical horticulture as does not exist in any other country.

The report then remarks on the different subjects of study, namely, physiology, meteorology, mathematical, historical, philological, and economical science.

"Physiology," the report says, "tends to assume in the scientific history of the nineteenth century the place of mathematics in the seventeenth, and of chemistry in the eighteenth century. It would be desirable that professorships should be created for it in the secondary medical schools, which are still in want of it." With respect to meteorology, the idea of establishing special observatories for it is entirely a French one, brought forward already one hundred and twenty-four years ago by Lavoisier, Laplace, Montigny, &c. ; taken up half a century later by the English and Americans ; resumed again in 1852 by the founders of the Meteorological Society of France, and afterwards by the Imperial Observatory, which is about to realise its purpose upon a great scale in the new park of Montsouris, thanks to the munificence of the City of Paris, where the charming palace of the Bey of Tunis, which was one of the architectural curiosities of the Champ de Mars in 1867, is to be reconstructed for its purposes. "The administration is obliged," the report states, "to admit, for mathematics as well as for literature, that it cannot assist either a mathematician to find new theorems, nor a writer to produce an immortal work." Nevertheless, the reorganisation of the Imperial Observatory, by the decree of the 3rd of April, 1868, will be full of advantages to the first of these studies, which besides will find at the Sorbonne and the Collége de France, in the grand laboratories of research there, any desirable assistance that instruments and collaboration can afford. The report, in referring to historical and philological science, makes reflections which are unfortunately but too well founded with respect to the existing debasement of taste for literary studies of high character.

Amongst the improvements to be employed, these are pointed out : the re-establishing of official competitions ; the multiplication or development of the means of popular instruction, such as libraries, periodical collections, &c. ; scientific missions, travels, voyages, and circumnavigations, which will be so ordered as to gain also in the interest of ethnography and philology ; by subventions and subscriptions ; and, finally, the reorganisation of the school for living or spoken Oriental languages ; a reorganisation which is at the present moment one of the principal anxieties of Government. The economical sciences, so important in order to insure the prosperity of the country and to preserve private property from those catastrophes to which inexperience and the inclination for adventures expose them, are the object of a special section which will be added to the *École des hautes études*, independently of chairs which will be added for that purpose to the *Facultés de droit de province*, and of a chair

which will be established at the *Collége de France* for the history of economic facts and theories.

The second part of the report refers to the means of giving to the system of superior instruction new activity; and these means are, in general, connected with the idea of decentralising this instruction, in order that there may be provincial institutions, so as to dispense with the necessity of applying to Paris for scientific assistance.

The creation of secondary normal schools and the establishing of competitions for admission to the academies is the corresponding development of this idea; and as the "academies" answer in the majority of cases to the former "provinces," these measures will give satisfaction to those who still possess that provincial patriotism which is no longer a danger, but which may become a power and safety, to the State.

The creation of scholarships, and the concession of more or less assistance to pupils of the higher intellectual grade, is another idea to which the Minister attaches justifiable importance. The children who, on account of their fathers' services to the State or to knowledge, may obtain scholarships in the secondary establishments, can only enjoy these until they are eighteen years of age; they then find themselves abandoned at a moment when assistance is most required. This is not the case in foreign countries; and the Minister cites the examples of Prussia, England, Belgium, and Italy, and proposes to imitate them, "so that the poor young man who shows a natural aptitude for science or literature may be also encouraged and assisted on the same general principles and in the same manner as those now are who show a like aptitude for the army, the navy, or engineering."

The report proposes the acceptance from foreign universities, more especially from those of Germany, of the useful arrangements of free instruction as in operation there, the importance of which must be admitted; that is to say, by instruction by lectures given by professors or doctors who have established chairs by the side of those which the titular professors occupy as *Privatdocenten* or *répétiteurs*. This becomes a valuable source of emulation, and developes in a striking manner the courses of study and its branches. The University of Berlin counts for the year 1868–69 in the philosophical faculty, which corresponds with our two faculties of science and literature, 58 courses in the different subjects to be delivered by the titular professors, and 131 to be delivered by free professors of different ranks. The report gives other information with respect to foreign universities, which could be applied in France with more or less advantage, but the details of which would lead us much too far.

Since the date of the law to which the above résumé of the ministerial report refers, we find that the system sketched out is already in great part in full operation. The grand normal laboratories in various parts of Paris are completed, and in the main provided with instruments for the very highest experimental researches.

It may be well to explain that while the apparatus of any ordinary chemical or analytical or physical laboratory, or any private observatory for meteorology, or for natural history or pathological microscopy, &c. &c., can be constructed and furnished with instruments for a moderate sum, at most a few hundred pounds—though even this is not to be had by every man capable of promoting science by discovery—yet chemistry, physics, &c. have now advanced to stages in which those who have reached the highest shelves of the hill of science find themselves utterly unable frequently to push their researches further for want of apparatus, instruments, or often trains of these, of so refined, costly, and complex a character that without the funds and aid of the State they are absolutely unattainable.

Such researches again often, to become of value, involve the laborious help of numerous skilled assistants working in concert and in rooms and buildings conjoint and provided with special appliances and apparatus, and often needing peculiar light or illumination and much besides.

It is to supply these to the high-priests of science that the French Government has come thus ably and nobly forward.

All the world saw admitted in 1867, at Paris, the palpable effects upon German and French industry of the two grand systems of general and special education long in use in those regions of Europe. France has seen that the rest of Europe, that America and the civilised world have become more or less alive to her success, and that as all the rest of the world, if it be wise, may, and it is almost certain will, take a leaf at last out of her book and that of Germany, and that so in the coming years she will find herself in her arts, industry, and manufactures, as well as agriculture, fought with her own weapon; so, if she is to maintain her place, it must be by supplementing and increasing her own efforts. She therefore has wisely asked herself what is the real fountain whence she and all nations draw their strength and their advances in wealth and power over nature; and she rightly traces these to *high science*, to abstract discovery, to scientific research after the truth as it is in nature, without any ulterior end or any view lower or baser than simply the search for truth.

How was she to help this, then, to stimulate the stream of scientific life-blood that is to vivify and quicken every working limb below in the body corporate? and her answer has been given in the heads sketched in the above report, and by the establishment of these great laboratories for the highest researches.

In these none will be admitted but those whose previous career prove them worthy of making use of these grand means, of taking part, as Bacon would have rejoiced had he seen it to say, as "light-bearers" in these noble "organons" for discovery.

One hundred and fifty-seven persons have been admitted already, divided as follows :—

| | |
|---|---|
| Mathematics | 15 |
| Physics and Chemistry | 51 |
| Natural History and Physiology | 47 |
| History and Philology | 44 |

Amongst these are men already with well-known reputations; some are Frenchmen returned from abroad to make use of the means here at their disposal, and some are foreigners.

In November last work began, and lectures in those laboratories and schools. At the Sorbonne the laboratories of physics, botanical physiology, and geology are confided to the direction of MM. Desains, Duchartre, Claude Bernard, and Hebert.

The vast chemical laboratories (those at Bonn, created by the Prussian Government, cost for building alone 10,000*l.*) are under the charge of MM. Pasteur and Saint-Claire Deville, while those of physics are presided over by M. Jamin.

At the College of France and at the *École normale supérieure* the laboratories will be under MM. Balard and Berthelot, with M. Pasteur for physiological chemistry.

At the Museum (*Jardin des Plantes*) M. Milne-Edwards will direct the laboratories for zoology, M. Decaisne for vegetable cultivation and vegetable physiology.

The provinces and the provincial "faculties of sciences," &c. have well responded to these enlightened views, and several have already placed themselves in affiliation with the great central scheme at Paris, and some offered money and subventions in support of the entire system.

A general council, composed of the directors and professors of the several schools and members of the Institute, will confer for the direction of such parts of the system as require united and uniform action. This is composed as follows :—

For the Mathematical Section—MM. Bertrand, Chasles, Delaunay, and Serres, with M. Puisseux.

For that of Physics and Chemistry—MM. Balard, Fremy, Wurtz, Desains, and Jamin.

For that of Natural Sciences—MM. Claude Bernard, Brogniart, Decaisne, Milne-Edwards, and Hebert.

For that of History and Philology—MM. Maury, Regnier, De Rougé, Waddington, and Breal.

Every name here almost is as the sound of a trumpet through the ranks of science.

It is scarcely possible but that this University of Science, when after a few years it has found its just position and functions in all respects and relations to France, must work well and be productive of incalculable service to that nation, and indeed to the world through her.

How poor and insignificant, lame, incongruous, and incapable, in contrast with it, seems all that we can show in Great Britain instituted by the State for similar ends!

It must at all times be a subject of deep regret that more energetic means are not adopted in this country for affording a wide class of earnest and intelligent students the means of pursuing their studies with suitable appliances, such as the resources of private individuals do not as a rule afford. We trust that the example which our Continental neighbours are setting will not be lost upon our observant legislators, and that, ere long, a better state of things in this respect will exist at home.—Ed.

## MULTITUBULAR BOILER.

(*Illustrated by Plate* 15.)

The arrangement of boiler shown on plate 15 has been introduced by Mr. J. Brown, now of St. Petersburg, Engineer. It is of the vertical multitubular class, and has a superheater arranged in the upper part of the smoke-box. Fig. 1 on the plate is a vertical section of the boiler; fig. 2 is a transverse section taken through the super-heater; and fig. 3 is a corresponding section taken through the boiler. The shell or casing A of the boiler is of a cylindrical figure, and encloses at the lower part the inverted conical or dish-shaped furnace B. The perforated frame of the furnace rests on a ring or circular bracket-piece, which is bolted to the inner face of the outer shell. The upper part of the furnace is enclosed by an inner conical shell C, which forms the main support of the tubes leading to the smoke-box. The upper part of this shell is connected with the top plate of the outer shell by a series of vertical tubes D, which convey the products of combustion from the upper part of the inner shell into the superheater E above. An inverted conical water space or box E is fitted inside the series of smoke tubes D, and the central portion of this water space is taken up by another series of smoke tubes G, through which the greater portion of the more highly heated products of combustion pass on their way to the superheater E. This part of the arrangement consists of a steam-chest arranged in the upper part of the smoke-box, in which is fitted a number of tubes H, opening from the lower to the upper portion of the smoke-box. The inner and outer water-spaces communicate with each other by tubular water-ways I, which open from the lower part of the water-space to the outer space. The steam as generated flows through the series of tubular openings K, which connect the outer shell with the superheater, and here it is exposed to the heated surface of the numerous vertical tubes H, and then passes off by the lateral steam-pipe L, shown in figs. 1 and 2.

The arrangement of the boiler is compact, and has been found to work well with a small consumption of fuel, and steam is got up very quickly on account of the large amount of heating surface it contains.

## ON METHODS AND TOOLS USED FOR FIXING TUBES.

Were we to go back to the commencement of the uses of tubes, when the necessity of their being fixed in series with either air, steam, or water-tight joints in tube plates began to be understood, we should have a somewhat lengthy, but nevertheless interesting history of one most important detail in mechanical engineering practice to follow out. We should have to lay down in order the trials made with "tubulous" as well as "tubular" boilers prior to the St.-Étienne experiments of 1828, to record the anxious overlooking and months of heavy toil undergone by Henry Booth, Robert Stephenson, and, we believe, Launcelot Young, in getting the "Rocket" boiler ready for the Rainhill competition; whilst in attending to this branch of tube-fixing alone any record would be but very incomplete, as it would leave out of consideration numerous other cases wherein an effectively fitted tube and plate joint have been found essential, as in the instances of surface condensers, brewery refrigerators, coolers, *et hoc genus omne*.

Yet, however much the effective fixing of tubes has been found an engineering difficulty to carry out with close regard to economy, the methods adopted in the several instances which we have enumerated are each totally different; and compulsorily so, from the conditions governing every individual case.

In the case of a steam-boiler, the joint is required to remain tight and secure under various and, more usually, very high pressure of steam, at correspondingly intense degrees of temperature; to resist which it is necessary to insure almost atomic contact between the metal of the tube and tube plate. Thus, expedients are resorted to whereby intense permanent local pressure to maintain the imperative degree of metallic contact may be derived. In the case of a high pressure boiler (locomotive, for example, with the spring balance set to allow the safety-valve to blow off steam at from 120 to 150 lbs. pressure per square inch), it is almost impossible to secure by mechanical appliances, in every case, that degree of closeness of the joints so that all of them in any given boiler will be tight; wherefore it is no unusual thing to find that after all the care of the boiler-smith has been used by driving conical drifts, and followed up by the (until lately) nearly universal method of driving in conical cast-iron expanding ferules, some 40 per cent. of the tube joints leak. But a boiler is *self-curative*, and we have often been on a locomotive engine running its trial mileage, with steam and water bubbling and hissing out from the tube joints at both fire-box and smoke-box ends to a highly injurious degree, yet we have examined the same boiler a few days, and sometimes a few hours afterwards, and found the leakage had stopped. But in the cases of surface condensers, refrigerators, and so on, the effects of high temperature and rapid corrosion through the pressure of a corroding (*i.e.* oxidising) liquid passing very rapidly over the leaky parts of the metallic joint do not obtain; therefore certain kinds of elastic packing which remain uninjured at low temperatures have come into use, either of hemp, flax, india-rubber, or other fibrous or expansive material; and these have been and continue to be employed in a variety of forms.

In the present paper we desire more particularly to direct attention to the methods and tools employed for fixing tubes in steam-boilers; and in every case, except in one very important example with which we are acquainted, it is well here to state that such fixing is effected by *expanding* the tube end to fill the hole made in the tube plate; whilst in most cases of surface condensers and refrigerators the tightness is secured by the *compression* of some elastic packing between the outer surface of the tube and the inner surface of the hole or recess in the tube plate.

In regard to the fixing of tubes in boilers, the expansion of the tube end to fit the hole in the tube plates was for a long time universally effected by the mere driving by hammer of a conical drift into the tube; and as the holes in the tube plates were bored parallel, the tubes could not by this method be made to thoroughly fill the holes except at the extreme outer ends or where the drift was of maximum diameter; nevertheless, in moderately pressed, and indeed we have known many cases of very highly pressed boilers, this method for a long time was the best known—additional tightness of the joint being secured by caulking the tube end and plate whilst the drift was inserted.

Afterwards, to increase the efficiency of the foregoing method of fixing by drifting, cast-iron truncated conical ferules were introduced, so as to maintain a constant outward pressure of the tube end into the tube-plate hole; but these were found to be sources of trouble, producing difficulties in the way of cleaning the tubes, also constituting prominences at the smoke-box end, whereby small pieces of coke, coal, and ash, which, had the tubes been free from such obstruction, would have passed through them, were retained; therefore, in many cases wherein the cast-iron ferules had been used, they were abandoned, and return was made to the fixing by drifting and caulking alone.

In a steam-boiler a well-fitted tube serves two purposes—namely, the provision of heating surface, and it also acts as a longitudinal stay: this latter feature has, however, in many designs for tube-fixing been entirely overlooked, more especially by French engineers, several of whom have proposed plans by which the tubes may be removed for both interior as well as exterior cleansing and scraping; but these devices are generally of that order which incurs the expense of very costly fittings, besides taking up so much more room in the tube plate that the effective heating surface of the boiler is diminished, through the mere impossibility of putting in so large a number of tubes; and the tubes when applied by such methods constitute but very inefficient stays, and for this reason, we believe, have never been widely applied.

As to the importance of some uot yet devised method by which the presently admissible number of tubes in a multitubular boiler may be maintained, and the tubes themselves rendered capable of expeditious removal and replacement, there canuot be a question ; and the discovery of such a method promises a sure aud certain reward to the inventor. For at present, when a tube has to be removed, it is altogether useless for being replaced in the same boiler, because the ends are generally corroded into chemical unity with the tube plate, and are bent and battered about into various tortuous forms, besides being split in the separation. Nor is this all the injury done, for it frequently happens that the hole in the tube plate is thrown so much out of form by rust and cutting, that it has to be re-bored—that is, enlarged—to render it fit for receiving a new tube. The loss incurred through the destruction of the tube ends was felt to be so serious in one factory with which we are acquainted, that a few years ago the superintending engineer proposed to employ a knife-cutter working in a lathe for the purpose of squaring off the ends of the injured tubes ; and he further proposed to use them again by putting on a short length of tube at one of the ends, jointing the two together by brazing over an interior ferule. We are not sure whether the proposal was carried out extensively, and we even doubt if it could be economically and with general success adopted, for many practical difficulties appear to us to lie in the way. Of late years some of the defects to which we have alluded have been partially overcome by the introduction of tools for cutting the ends off the tubes before they are removed.

To return, however, now to consider the methods and tools employed for expanding the ends of the tubes outwards so as to fit the tube-plate holes.

Some years ago, when the necessity for doing this in a more rapid manner than by the "hammer and plug" method was seriously felt, several forms of expanding mandrels cropped up, some actuated by screw pressure and others by hydraulic pressure ; but all these have now yielded to those forms of tube expanders in which the expansion is produced by the stretching action of a series of rollers revolving inside the tube and pressed outwards by means of a central cone. Until quite recently the tool made by Dudgeon of New York was undoubtedly the most rapidly acting and in all respects the best tool for the purpose which engineers possessed. Yet Dudgeon's expander has some defects, amongst which we may mention the impossibility of producing a parallel expansion of the whole length of the expanded part of the tube, so as to fit perfectly the hole in the plate, except when the central taper mandrel is driven fully in, so that the parallel upper end of it bears throughout their entire length upon the rollers ; and whilst the tube-plate holes may sometimes be of size to enable the mandrel to be driven in so far, yet it can only in few cases be so.

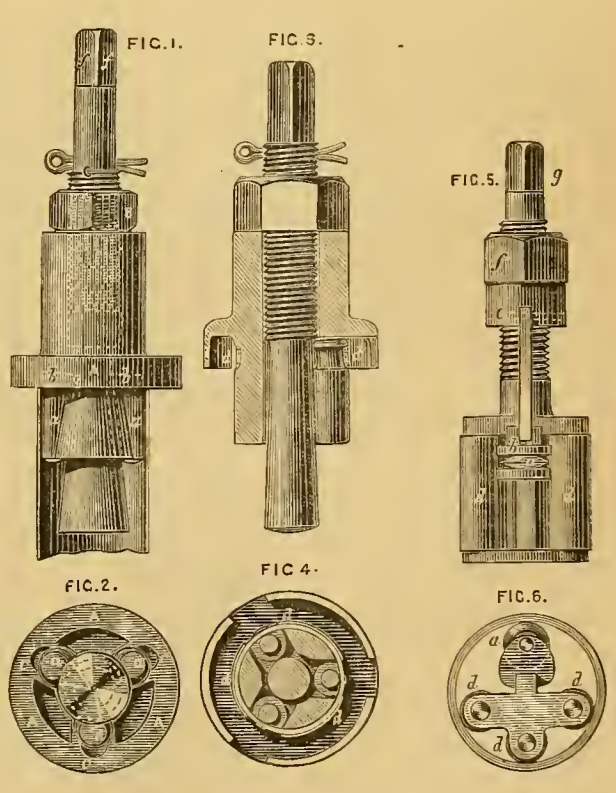
Dudgeon's expander, although for a year or two now pretty largely used, must, we are disposed to think, give place to another form of expanding instrument introduced by Mr. Thomson, engineer, of Glasgow ; and although only a few months before the public, this instrument has been made and sold in very large numbers.

Like Dudgeon's instrument, Thomson's also consists of a central cone and surrounding rollers, Dudgeon's rollers being *parallel*, whilst Thomson's are truncated cones. In Thomson's expander the taper of the rollers lies opposed in direction to the taper of the mandrel, and the ratio of taper on each being equal, necessarily insures that points in the circumference of the rollers lie parallel to each other ; thus producing a parallel expansion of the end of the tube so as to thoroughly fill the hole in the tube plate. Thomson's expander being the most recent, we have thought it desirable, in order to give additional clearness to our previous remarks, to illustrate by woodcuts.

The instrument is made in several forms, two of which are shown at figs. 1, 2, 3 and 4 ; figs. 1 and 2 being an elevation and plan of one arrangement, figs. 3 and 4 a vertical section and plan of another arrangement. In figs. 1 and 2 the expanding rollers *a* are held by circularly dovetailed heads *b* in dovetailed radially situated recesses *c* formed in the body A, so that they cannot fall or be pulled out. When that part of the instrument which secures the rollers *a* is placed within the end of the tube to be expanded, the nut B is tightened on the screw C against the head of the body A. This has the effect of drawing the large end of the central conic mandrel inwards, and it therefore presses out the rollers *a* against the interior of the tube. When they are thoroughly tightened so as to press the tube against the hole in the tube-plate, the whole instrument is rotated in the tube by applying a winch handle or wrench to the required end *f* of the central spindle. When the expansion of the tube has been effected, the instrument is removed by loosening the nut B, thus allowing the central spindle to be pushed inwards, and therefore releasing the pressure on the cones. In the other form of the instrument shown at figs. 3 and 4 the action is the same as in the preceding, but the cones are held in place by the flexible steel or elastic ring *d*, which embraces recesses in their necks.

Instruments founded on similar construction to the expander have also been introduced by Mr. Thomson for cutting tubes also for withdrawing both ferules (when these are used) as well as the short pieces of tube from the tube-plate, without injuring the holes therein. The tube-cutter is shown at fig. 5 in elevation, and at fig. 6 in end view. The cutting disc *a* is carried on an axis in the carriage *b*, which is hinged by a bar to the body of the instrument at *c*. The body also carries rollers *d*, and in the centre the taper guide *e* ; and as the carriage *b* and cutter *a* are forced downwards upon the guide *e* by the nut *f*, the cutting disc *a* is forced out against and into the metal of the tube to be cut. By turning the instrument round with a wrench applied at the squared end *g*, the disc *a* being forced out cuts an even indentation all round the interior of the tube, two or three revolutions being sufficient to cut ordinary boiler tubes completely through.

The tool for withdrawing ferules or the cut-off ends of tubes from tube plates is shown in elevation at fig. 7. It consists of a spindle A having a cone B formed at one end. A hollow cylinder C, fitted with a number of claws D, is fixed around the cone B, so that by tightening the nut E against the bridge F the cone B is

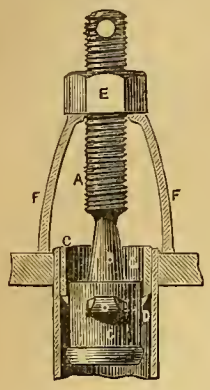



drawn backwards ; thus expanding the claws D so as to catch against the inner edge of the ferule G, and by continuing to tighten the nuts E the ferule G is drawn out.

We have before merely hinted at one exceptional mode of securing boiler tubes based upon the reverse foundations of what we

have heretofore more especially considered; that is, the plan of M. Berendorf of Paris, and which, we believe, has been pretty largely used by the firm of Cail & Co. of Paris. The plan consists in boring the tube-plates with holes of larger diameter than the tubes to be inserted; in the annular space which obtains around the tube when it is inserted a double-coned ring is inserted; this, on being driven in, acts with its outward conical face, by filling the hole in the tube-plate, and the inward hollow coue becomes compressed around the tube end. Berendorf's plan is said in certain cases to have answered well, and we know that it is at present being looked upon attentively by boiler-making firms in the north. Our opinion of the method is that it may answer well for boilers not worked above a medium steam pressure, but it is quite evident that tubes when so fixed cannot act with nearly so much efficiency as stays, as when secured in the tube-plates by expansion outwards; and although the system may afford more facility in the removal and replacement of the tubes, which we fully admit, still it is quite clear that the heating surface of the boiler is reduced, on account of the space taken up by the rings preventing so large a number of tubes being inserted in any given dimensions of tube plate.

Fig. 7.




We expected to have extended these remarks to the fixing of surface condenser tubes; but as the paper has now reached some length, we prefer to treat that branch of our subject in a second paper next month.—V. D.

(*To be continued.*)

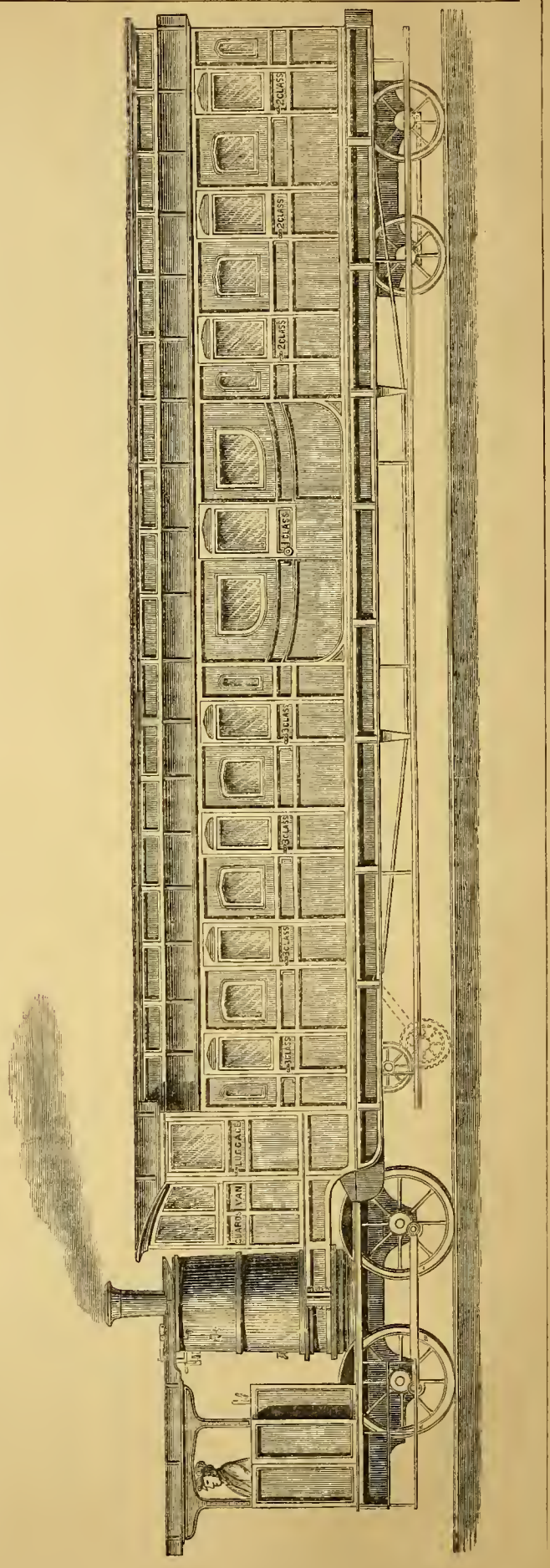
## THE FAIRLIE ENGINE AND CARRIAGE.

We are glad to observe that attention is being given in the proper quarters to the subject of light locomotive engines combined with light rolling stock. This highly important matter, involving as it does considerable economy in the management of railway lines, is now receiving from many officials the attentive investigation that should have been devoted to it long since. The satisfactory results that have been obtained by the use of the Fairlie system of carriages may well warrant railway engineers in looking forward to effect a very considerable saving in the cost of rolling stock, as well as the wear and tear of rails; and the public, we think, may reasonably expect that ere long a striking change will be made in the present system of conveying the passenger traffic of our metropolitan and branch lines, resulting, as we earnestly hope, in the increased comfort and safety of the passenger, as well as the reduction of fares.

The accompanying engraving shows an elevation of an engine and carriage combined, specially designed for working passenger traffic on branch or city lines and for light railways, by Mr. R. F. Fairlie, C.E. The idea has been worked out in conjunction with Mr. James Samuel, C.E., who has devoted much time to this subject. The steam-carriage consists of two bogie trucks, each having four wheels. One of the trucks at the leading end carries the boiler and engines and supports one end of the carriage, while the other end is carried by the second truck. The first or engine-truck is made of side and cross frames in the usual manner, saving that steel is used wherever it is found desirable to do so for lightness.

The foot-plating extends over and covers in the frames, giving sufficient area to carry a vertical or circular boiler, besides ample room for fuel and for the driver under the foot-plate and between the frames; cylinders 8″ diameter are fitted with a stroke of twelve inches, as also the whole of the gearing, except the reversing and driving lever connection; these lead to the foot-plate, and are fixed conveniently for the driver. The wheels in the engine-truck are 4 feet diameter, and coupled together.

The boiler, which is circular in form, stands on a circular hollow pedestal, placed midway between the four wheels, the outside of



this pedestal forming the centre of the swivelling action of the bogie, and the inside an ash-pit under the boiler fire. One end of the carriage or carrier frames is made to converge and fit like a belt or strap round the pedestal, with brass lining pieces to prevent any adhesion of the rubbing surfaces, and to permit the engine bogie truck to revolve one quarter of a circle. The carrier or carriage platform, one end of which is made to fit as described round the pedestal, thus rests and is supported on the centre of the engine frame; the other is supported on the centre of an ordinary bogie truck with four wheels 2 ft. 6 in. diameter. The carrier platform, besides keeping the bogie trucks at their proper distances apart, has to do all the work of supporting the carriage body, to receive all shocks from collision or sudden tension, and to carry the water necessary for feeding the boiler.

It is made of four frame plates, running parallel to each other, and framed together with cross pieces and diagonal ties; the two inside plates are 4 feet apart, and these are in turn 2 ft. 3 in. from the outside plates; the space between the inside plates is fitted with a top and bottom, thus constituting a long narrow tank. There is one tie rod trussing each frame plate, to give it the necessary vertical strength. On the carrier frame a carriage body is fitted: it is kept separate from the framing, and forms no part of it, consequently it may readily be removed for the purposes of repairs and another one placed in its stead, or by taking off the cap of the strap—which embraces the pedestal or bogie centre—and lowering down a temporary pair of wheels attached to the leading end of the carrier frame, the engine can be removed and another one placed in its stead. The calculated weights of the locomotive and carrying trucks and carrier frame, water and fuel, for 40 miles' run, is under 14 tons, and loaded with 90 passengers is only about 20 tons.

It will be seen, therefore, that the ratio of dead weight to the carrying power is only about 2½ tons to 1 ton of paying load, the greatest proportion of paying to dead weight ever obtained.

The weight available for adhesion being always about 55 per cent. of the total weight of the train, the question of sufficiency of adhesion need not enter into our calculations, it being ample under any condition of the rails to ensure the working of gradients of 1 in 20.

The total weight being only 20 tons, it follows, taking the friction of the two bogies to average 10 lbs. per ton, and adding 10 lbs. per ton for atmospheric and other resistances due to a 40-miles velocity—an ample allowance—that it requires only a tractive force at the rails of 400 lbs. for the whole 20 tons of train.

A pair of 8″ cylinders, with 12″ stroke and 4-ft. wheels, with a mean pressure in the cylinders of 100 lbs. to the square inch, gives a power of 1,600 lbs. at the rails, or four times the amount required; but having 40 miles an hour on a level as the basis of this calculation, let us see what would result from working a mean gradient of 1 in 100.

Gravitation, on an incline of 1 in 100, will add 22½ lbs. per ton to the resistance already stated, in all 42½ lbs. per ton. This figure gives the force required to move 20 tons at 40 miles an hour up 1 in 100 to be 850 lbs., still leaving a balance of 750 lbs. excess of power, by which an additional carriage could be taken with a like number of passengers, say 180 in all. The quantity of fuel consumed should be as follows: Assuming the whole force of the engine at the rails (1,600 lbs.) is absorbed in doing duty, it in effect will represent 170 h.-p.; and if we take 3 lbs. of coal as producing one h.p., it will give a total of 510 lbs. of coal for 40 miles, or under 13 lbs. per mile; supposing the evaporation is equal only to 7 lbs. of water per lb. of coal, it will give a water consumption of about 8¾ gallons per mile, or 350 gallons for the 40 miles.

Although the extreme wheel base is 57 ft., the actual wheel base, limiting the curves, is that of one bogie only: this being 6 ft., the limit of curve, which can be worked with safety, is about two chains, but at a slow speed a curve of 35 feet radius can be passed; curves of this radius being placed at the termini to run the train round, and thus avoid the expense of turntables.

The engine requires one man only to work it, thus saving considerable expense, and the guard, who is situated close to the driver and in immediate communication with him, has charge of the brakes, which are supplied to all the wheels alike. The driver can also apply the brakes independently of the guard. It will therefore be seen at once that for quick stopping and starting nothing could be better arranged, as, instead of the usual heavy engines and trains, there is a weight only of 20 tons to stop and start, being equal to the weight of an ordinary engine-tender in working order.



## THE PRESERVATION OF ANIMAL FOOD.

Our readers are already aware that more than one commercial enterprise has been launched with a view to the better preservation of animal food, and the consequent utilization of the superabundant animal wealth of distant countries. Recently the results of Professor Gamgee's discovery in this branch of art were submitted to the Food Committee of the Society of Arts. The meat had been killed and cured in New York, and was sent to this country in ordinary packing cases, with a view of testing the capability of the process for sending out foreign beef or mutton at a low rate of cost. The committee in their report pronounce the meat "untainted and well preserved," they express considerable interest in the process, and think it affords great promise of success. They are, however, desirous of informing themselves more particularly as regards the action of high temperature in counteracting the preservative effect of the chemicals employed. In America no question seems to be entertained that the great desideratum in meat-preserving has been attained, and that this system will convert into a steady source of wealth the thousands of cattle whose carcases are now annually sacrificed for their hides and horns alone.

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## RECENT PATENTS.

### SAFETY LAMPS.

Thomas Storay Horn, *Newcastle.—Patent dated May* 28, 1868.

This invention relates to a means of obtaining an increased amount of light and more perfect combustion in miners' safety lamps than has hitherto been obtained, whereby little or no unconsumed carbon or soot is deposited in or upon the lamp, and it is rendered moreover thoroughly inexplosive, whilst the light is immediately extinguished should the lamp by accident or otherwise be overturned. The invention has reference also to an improved lock for fastening all the parts of the lamp together.

Fig. 1 of the subjoined engravings is a vertical section of the improved lamp. Fig. 2 is a sectional detail of the locking arrangement. A is the oil reservoir and base of the lamp, provided with a tube B in the centre for the reception of the wick or cotton and for replenishing the reservoir with oil. C is the air chamber screwed at *a* to the top of the oil reservoir, the top plate *b* of the air chamber is finely perforated, and the circumference of the chamber is composed of wire gauze *c*. D is the combustion chamber

surrounding the wick, the top of this chamber being formed by the removable metal dome E, which has a central aperture for the passage of the wick. A bayonet joint connects the dome E with the ring F. This ring has an annular dovetail groove *d* on its upper surface for the reception of the lower edge of the glass chimney G, which is permanently cemented therein, a bead or groove being made round the top and bottom of the glass chimney in order to form a more secure hold for the cement. The ring F is screwed into the outer ring H, which forms the upper portion of the base of the lamp, being screwed thereon at *e*. This ring H is perforated circumferentially, as shown at *f*, in order to admit air horizontally into the air chamber C. With a view to protect the air chamber from any sudden gust, "blow" or outburst of gas or air, an outer perforated guard I, of an annular form, may be applied round the perforations *f*. This guard may either be made solid with the ring H, where a series of perforations *g* are shown both at the top and bottom, the perforations *f* being dispensed with, or it may be a separate loose attachment, with perforations at the bottom only, in which case it can be fixed in position by one or more screws if desired. The products of combustion pass up the glass chimney G, through the contracted aperture *h* in the metal cone K, which is fitted to the top of the chimney. This cone is enclosed in a double cap of copper, the inner one I being perforated at the sides and top, whilst the outer one M is only perforated at the top. The cone and caps may be readily removed for the purposes of cleaning or repairs. The glass chimney may be enclosed with a wire gauze cage N as a protection against breakage if found requisite. When using the wire gauze it is secured in its place by nipping the lower edge between the ring F and the part H. The various joints in the lamp are made sufficiently tight to exclude all air, excepting that which passes through the air chamber C, so that should the gauze N be taken out the lamp will remain as safe as before.

Fig. 1.

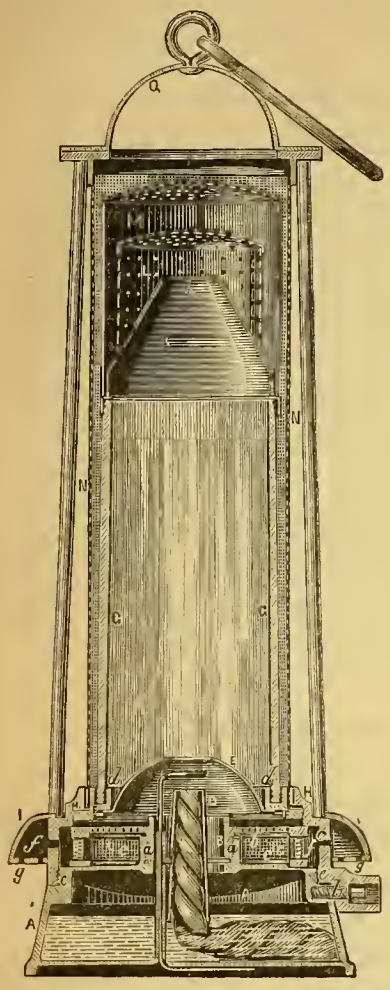
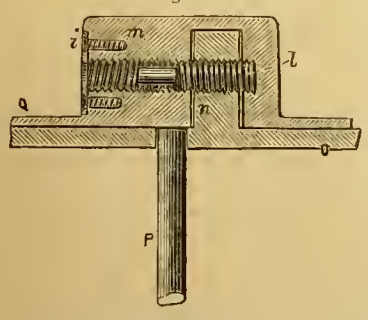



Fig. 2.




The mode of locking the lamp is shown in fig. 2, and consists of two holes which are respectively drilled in the top rim O and bottom flange, the last-mentioned hole being continued as shown at *i* into the metal of the base A of the lamp; P is a sliding steel rod held upwards when left free by a helical spring, such rod when forced down entering like a bolt into the recess or spring *i*, and thereby effectually preventing the base from being unscrewed. This rod is held down by the hinged cover Q of the lamp (shown turned back in fig. 1), such cover pressing upon the top of the rod P when closed, and keeping it in its locked position. The cover is locked when shut down by means of a concealed screw *l* (shown in the sectional detail fig. 2), having an oval-shaped head which fits a correspondingly shaped key.

This screw is contained within a piece of metal *m* fast on the cover, this piece of metal having a slit or opening therein for the entrance of a metal tongue *n* on the rim O. A hole is made transversely through the metal tongue *n*, and when the parts are in their closed positions the screw *l* is turned by a key for that purpose so as to cause it to pass through the hole in the tongue, thus locking the cover down and maintaining the lower end of the rod P in the aperture in the base of the lamp. A small plate serves to prevent the entire withdrawal of the screw from the lamp, but so soon as the end of the screw is withdrawn from the tongue the spring *k* forces upwards the rod P, and leaves the base A free to be unscrewed or detached. A small pin *p* in the rod P prevents it from rising too high. It is preferred to place the lock at the base when using a gauze protector, the concealed screw *l* having an oval-shaped head entering direct into a hole or recess in the side of the base. In this arrangement of lock the top or cover Q should be permanently fixed to the rim.

## ELECTRIC TELEGRAPHS.

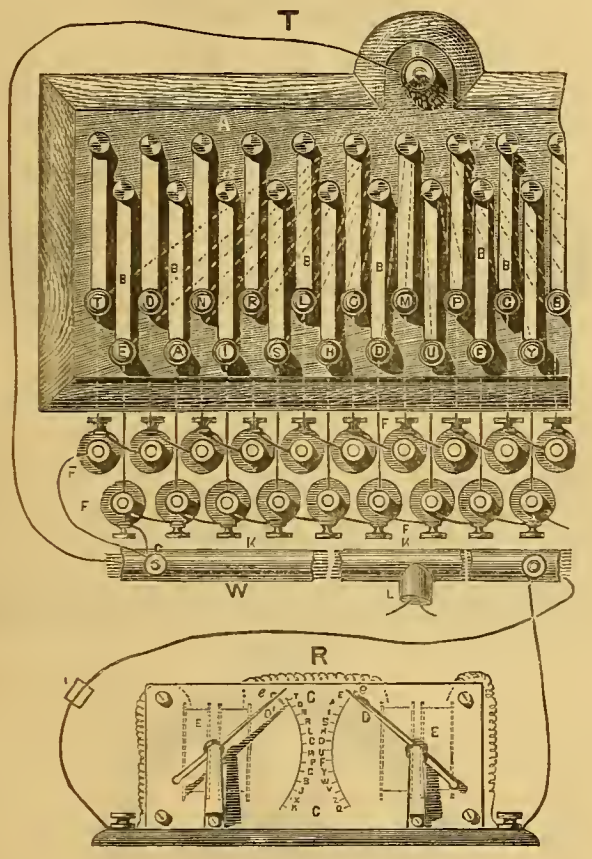
WILLIAM PETER PIGGOTT, *London.—Patent dated March* 25, 1868.

THIS invention relates, firstly, to an improved mode of, and apparatus for using or working the statically charged or induced land or submarine wires or cables described in the specifications of Letters Patent granted to Mr. Piggott, bearing date the 3rd of December 1860, No. 2957, and the 28th of August 1865, No. 2213, whereby electro-telegraphic messages may be transmitted by a cheaper and more simple arrangement of apparatus than heretofore. According to this part of the invention, it is proposed to connect with one end of the statically charged or induced transmitting wire or wires any number of batteries or "ganglions," each battery or ganglion being connected by a wire or wires with one or more of the stops, contact points, or "anvils" with which the keys of the transmitting instrument are brought in contact. Each key may represent a different letter of the alphabet, and corresponding letters are placed upon the dial or face plate of the receiving instrument; or, if preferred, in lieu of the letters being on the dial or face plate itself, a corresponding series of radial slits may be formed through the dial or face plate, which should be so placed as to enable rays of light to be cast by means of a reflector through the dial or face plate on to a screen containing the letters, each separate ray being directed on to its own letter. The different stops or keys in the transmitting instrument bring into action different tensions, or, in other words, effect a greater or less disturbance of the charge in the statically charged cable or wire; and consequently the indicator or indicators of the receiving instrument will describe a greater or less arc, and, by casting a shadow through one or other of the slits in the dial or face plate on to the screen, will indicate the particular letter sign or numeral transmitted, or the same letter or numeral may be pointed out directly on the dial or face plate itself by the indicator. In order to insure the indicator of the receiving instrument always returning to zero or the arresting stop on the dial or face plate, there is interposed between the receiving instrument and the end of the charged wire or cable one or a series of resistance coils of different lengths or other suitable resisting medium; so that, by connecting one or more of such coils, any desired amount of resistance can be obtained according to the degree of induction of the charged wire or wires.

When a single wire is used the batteries or "ganglions" at one end of the wire and the receiving instrument at the other are connected to earth, but if two wires are employed then the earth connections may be dispensed with.

The second part of this invention relates to Land Telegraphs only, and consists of a simplified and improved construction and arrangement of the induction or statically charged cables or wires

described in the specifications of the patents above referred to. According to this part of the invention one of the elements is made in the form of a tube or trough, which may be open along the upper surface for the facility of introducing the wire of the opposite element therein, such tube or trough forming at the same time a protective casing and receptacle for the wire. The trough or tube may be made of iron and have copper wires placed inside it, or iron wires may be placed inside such iron tube or trough, in which case the iron wires will be connected to ganglions or batteries; thus rendering the iron wires either statically positive or negative whilst the iron tube or trough is in the opposite electrical condition. These tubes or troughs are made in suitable lengths, and are connected to each other by any convenient arrangement or form of joints. When the trough shape is adopted, or when a split or open tube is used, a suitable covering may be




provided if desired, but it is not absolutely requisite. The elements may be kept charged either by the aid of batteries or "ganglions" at the extremities as before described, or by surrounding or enclosing the internal wire or wires with gypsum or other suitable earth, saturated with any of the well-known deliquescent salts suitable for the purpose. When a number of wires are employed, messages can be received from any point in the length of the outer trough or tube by causing the internal wires to branch off at the different points required, such branch wires proceeding to one side of the receiving instrument, whilst the other side of such instrument is connected by a wire with the surrounding or outer tube or trough, or with an earth plate.

In the accompanying engraving, R represents a front elevation of one form of a receiving instrument, constructed with a view to carrying out this invention. T is a plan of a portion of one form of transmitting instrument which may be employed in transmitting messages by means of the improved statically charged cable or line wire lettered W. The statically charged cables or conductors, as described in the specifications of the patents above referred to, may be used and worked in the following manner. The transmitting instrument T may consist of any well-known arrangement of keys or stops and anvils, as, for example, those known as Hughes' or Bain's instruments; but the arrangement shown will serve to indicate the mode of carrying out the first part of this invention. It consists of a stand A carrying a number of keys B, each key being provided with a contact point which is brought in contact with an anvil by depressing the front end of the key. A spring is placed under each key for the purpose of maintaining the keys elevated; *d* is an adjusting screw for regulating the movement of each key. In the woodcut the letters are marked on the keys in the same order in which they appear on the dial or face plate C of the receiving instrument in order to render the mode of working more easily understood, but in practice it is preferred to arrange the letters on the keys in alphabetical order. Two separate indicators D D′ are shown, each working over its own series of letters, and in the transmitting instrument two rows of keys are shown, the one serving to actuate the indicator D and the other the indicator D′ as explained below.

In lieu of having two indicators, one only may be used, in which case it will be convenient to dispose one half of the alphabet, or other series of signs, on one side of the zero point, and the other half on the opposite side. In the first-mentioned arrangement the indicators are maintained when at rest against the stops *e e′* by the action of the helices E E′ upon their respective needles, such helices being wound in opposite directions.

It will be observed that the indicator on the receiving instrument when signalling must describe a greater or less arc according to the position of the letter or its distance from zero; and in order to accomplish this a greater or less electrical disturbance of the static charge induced in the wire or cable is produced, either by supercharging such wire or cable or by diminishing the charge in the same. When supercharging the wire or cable, the front row of keys in the transmitting instrument T are employed, this row corresponding to the letters or signs pointed out by the right-hand indicator D; and when diminishing the charge in the cable or wire the second row of keys is employed, the letters or signs on which correspond to those of the left-hand indicator D′. F F′ are two series of small batteries or "ganglions," composed of carbon and zinc or any other suitable pair of elements capable of sustaining a uniform power for a considerable period. These ganglions are each connected with a separate anvil in the transmitting instrument and with the next adjoining "ganglion" of the series. The zinc of the first ganglion of one series F is connected with the positive element of the cable or wire as shown, by the binding screw G, whilst the carbon of the first one of the second series F′ of ganglions is similarly connected to the positive element of the statically charged cable or wire as shown. The anvils of the front row of keys are all separately connected with the carbons of the several corresponding ganglions, whilst the anvils of the second row of keys all communicate with the zinc of their respective ganglions. H is a central terminal to which the several wires from both series of anvils converge, and to which is connected the signalling wire for that station.

As the carbon of one ganglion is connected with the zinc of its neighbour in each series, it follows that all those ganglions which interpose between the anvil and earth, or between the anvil and the positive element of the statically charged cable or wire, will be brought into action, and will consequently supercharge the already statically charged cable or wire or partially discharge the same, the amount of electrical disturbance depending upon the number of ganglions brought into circuit; for example, if the letter E be wanted, one ganglion only (No. 1) will be brought into connection with the statically charged cable or wire, and as a very slight electrical disturbance will take place in the cable the indicator D of the receiving instrument will only move through a very small arc sufficient to point out the letter E. If the key A be pressed down, then two ganglions (1, 2) will be brought into action, and the indicator D will move to the extent of one letter further; and so on with each series or row of keys, till, by depressing the last keys of either series, the full series of one or the other set of ganglions, as the case may be, will operate, and the indicator will describe its greatest arc. Or, in lieu of using several distinct ganglions of equal power, a single ganglion or battery may be employed, using different tensions of it by bringing one, two, or more plates into action according to the amount of disturbance in the statically charged

cable or transmitting apparatus required. I represents one of a series of resistance coils of different lengths, which may if required be interposed between the charged wire and the receiving instrument in order to obtain any amount of resistance according to the degree of charge in the wire or cable. W illustrates in plan one mode of carrying out the second part of this invention, which consists in making one of the elements of the statically charged pair constituting the cable or transmitting appliance in the form of a tube or trough of opposite electrical condition to the wires enclosed within it. In this arrangement the insulated copper or other wires are enclosed in an iron tube K, which tube is connected at one end with one side of the receiving instrument R, and at the other end with one side of the transmitting instrument T, or with ganglions or batteries as shown in the engraving. Each copper wire is connected at one end with the opposite side of its receiving instrument to that to which the outer tube is connected at that particular station, whilst the other end of such wire is carried to the central terminal H of the transmitting instrument of the same station. The internal wires may branch off at any desired part of the iron tube as shown at L, in order to enable signals to be received at various places along the line, the tube containing as many wires as there are signalling stations. This tube is made in convenient lengths for the insertion of the wires through it and the wires. The several lengths of tubes are subsequently joined together in any convenient manner.

In all cases the outer tube is connected either directly with the instruments or with one or more ganglions or batteries, in order to insure the combined tube and enclosed wires being always charged with induced electricity.

## GETTING AND HEWING MINERALS.

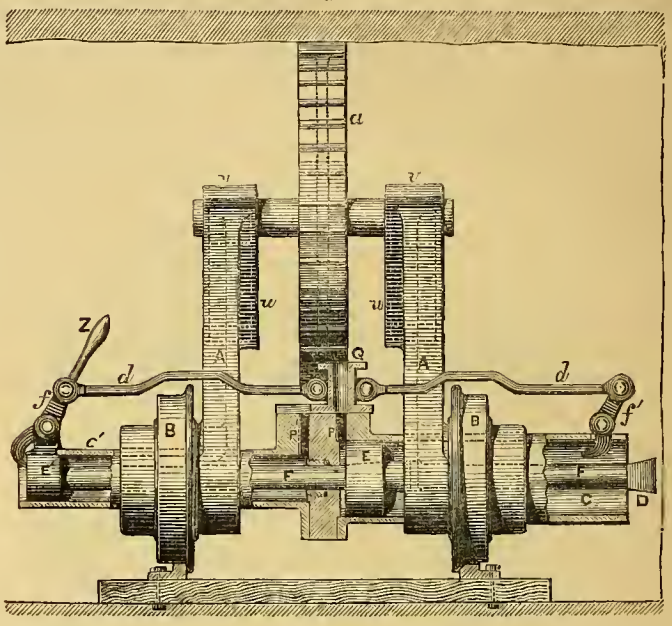
JOSEPH ROTHERY, *Leeds.*—*Patent dated April* 13, 1868.

THIS invention relates to the construction, arrangement, and combination of the cylinders, pistons, piston rods, connecting rods, and picks or cutters of machinery or apparatus employed in getting and hewing coal, stone, or other minerals, whereby an economy of power is obtained, the machine is rendered more steady when in action, and the distance or space between the pick head and the actuating cylinder of the machine is reduced. According to one mode of carrying out this invention, it is proposed to combine together, end to end, two cylinders of different diameters, open at their outer ends, and each having a piston working therein. These two pistons are both fitted on to the same rod, which works through a stuffing box in a stationary division or partition between the two cylinders. The object of the smaller cylinder and piston is to produce the return or back stroke of the pick or cutter, whilst the larger cylinder serves to give the cutting blow or stroke to the said pick or cutter: the connecting rod, which transmits motion to the pick axis, is partly contained within the actuating cylinder itself, thus economising space. Two cylinders of the same or different diameters, arranged as above described, may be used as a motive-power engine for various purposes.

According to another modification, the outer ends of the two cylinders are closed, the piston rod passing through a stuffing box in the end cover of the smaller cylinder. These two cylinders are open to each other at their inner ends, and are each provided with a separate piston carried on the same piston rod. The steam or compressed air is admitted behind the larger piston to produce the cutting blow, and is then admitted in front of the smaller piston to produce the return stroke of the cutter. In another modification, the two cylinders are placed side by side, and are closed at the rear end and open at the front end. The pistons of these two cylinders work in opposite directions, and are connected by connecting rods contained within the cylinders to short lever arms on opposite sides of the pick axis. The two cylinders, and the parts in connection therewith, are carried on an adjustable bed plate, which turns on a vertical pivot on the truck or carriage of the machine, in order to allow the pick to work on either side of the machine as required.

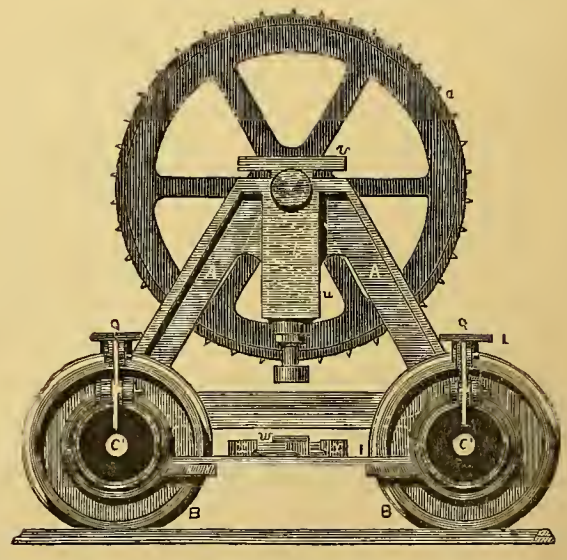
Fig. 1 of the accompanying engravings represents an end elevation partly in section of one modification of the apparatus, and fig. 2 is a side elevation of the same. In this arrangement two cutting tools are employed, D, each tool being actuated by a large and small cylinder C C′ of its own; and in lieu of the tools being in the form of picks, working or vibrating on a centre, they consist of straight cutters in a line with the piston rods F, and thus operate directly from the centre of the cylinders. The cylinders, moreover, instead of being bolted or otherwise secured to a truck or carriage,

Fig. 1.




form the axles of the running wheels B, the latter being mounted loosely thereon. By this arrangement space is economised and the cutters are made to work close to the floor. The two cylindrical axes are connected by a pair of upright frames or standards A, which at their lower ends embrace the cylinders and support a large propelling wheel *a*. This wheel has a roughened or ribbed periphery, and bears against the roof of the working. A pair of adjustable helical or other springs *t*, contained within spring boxes

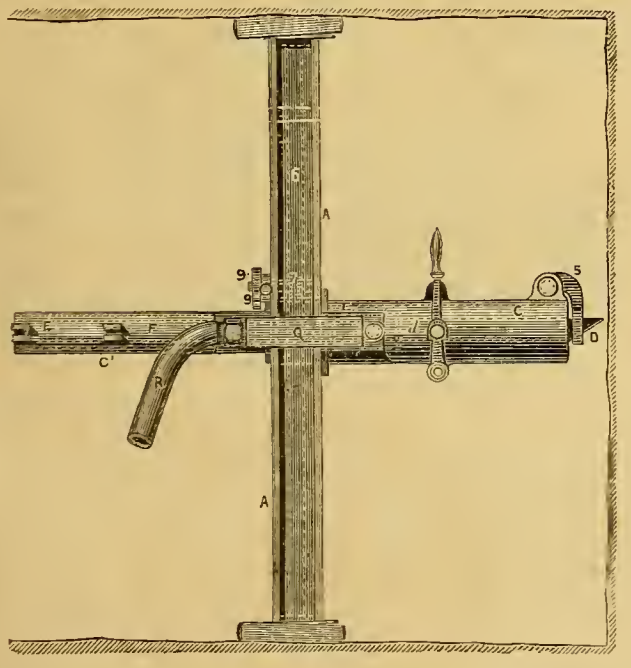
Fig. 2.




*u* in the standards A, serve to keep the vertical sliding bearing *v* of the propelling wheel elevated, and maintain the rim of the wheel pressed by an elastic or yielding pressure against the roof. In moving the machine along, the attendant simply seizes the rim of the wheel and turns it by hand as required. Q are the slide valves for the two pairs of cylinders worked by the valve rods *d*, which are jointed to upright levers *f f′*, carried on the outer ends of the large and small cylinders, and having their lower arms curved and

projecting inside such cylinders. As each piston E E′ arrives at the outer extremity of its cylinder, it strikes the inner curved end of one or other of the levers *f* or *f′*, and thus moves the slide valve. A flexible pipe is attached to the upper part of the valve, and serves to convey the steam or compressed air to the large and small cylinders alternately of each pair (the two cutters cutting at the same time,) through the ports P and P′, the exhaust taking place through the port which for the time being is open to the atmosphere. The handles Z are for facilitating the working of the valves by hand when requisite. The cutter, actuated by the leading pair of cylinders, makes a cut of say 18″ in depth, and is followed by the rear cutter, which commences its cut at the bottom of the groove made by the leading cutter, by which means a groove 3 feet in depth may be made at one passage of the machine. In order to enable the second cutter to work freely, it is necessary to remove the dust and fragments left in the groove by the first cutter, to accomplish which an endless pitch chain carrying a series of scrapers is combined with the machine. This chain is passed round two chain pulleys, which are connected by flat top and bottom bars projecting inside the groove. The pulley works on a stud pin in one of the pair of tie bars bolted to rings, fitting loosely round the cylinders, and a pin or bolt is passed through the bars and opposite tie bar in order to maintain the bars *z* steady. If requisite, the pulleys may have spur teeth formed thereon, gearing into corresponding teeth inside the links of the endless chain, in order to prevent any

Fig. 3.




slip. Rotatory motion is imparted to the pulley, either by a small cylinder for that purpose, or by gearing or other suitable mechanical contrivance.

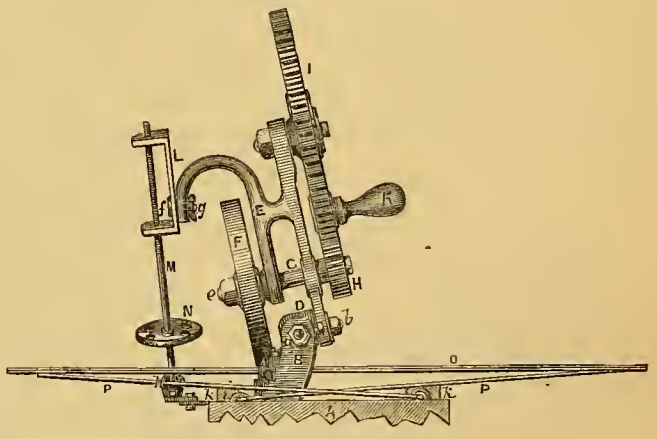
Fig. 3 represents a side elevation of another mode of applying and arranging the large and small cylinders for actuating the cutters of machines for getting and hewing coal, stone, and other minerals. In this modification the great object is to obtain a light and portable machine which may be easily carried in the hand of a collier or miner, and worked by him as a part of his usual tools or implements, in lieu of requiring a special attendant, as is the case with existing coal-hewing machines. C C′ are the large and small cylinders, supported between two struts A, which are wedged in a vertical, horizontal, or inclined position between the floor and roof, or between the two sides of the working. A stuffing box is provided in the partition between the large and small cylinders, and the two pistons E and E′ are secured to the same piston-rod F, which carries at one end the straight tool or cutter or cutters D. The slide valve Q works between dovetailed ledges on the cylinder face, and has a flexible steam or compressed air-pipe R secured thereto. *d* are the rods for actuating the slide valve; they are jointed to each end of the slide, the one being connected to a tappet lever worked by an anti-friction roller on the small piston E′, whilst the other rod is connected to the hand-lever, for moving the valve by hand when required. 4 is a helical or other spring for imparting the return stroke to the valve. 5 is a forked guide hinged on to the end of the larger cylinder, and embracing freely the square shank of the tool, thereby preventing any tendency it may have to turn round. The cylinders are caused to move along their supports as fast as the groove is cut, whether in a vertical or horizontal direction, by means of a rack and pinion, the axis of the pinion being carried on the cylinders, whilst the rack is cast on or secured to the inner face of one of the two struts. On the axis of the pinion there is a ratchet wheel, which is worked by a pawl hinged to the hand lever. By suitably working this lever the cutting tool may be readily fed up to its work as fast as the groove is cut.

## SHARPENING THE CUTTERS OF REAPING MACHINES.

James Hemington, *Chatteris, Cambridge.*—*Patent dated June* 18, 1868.

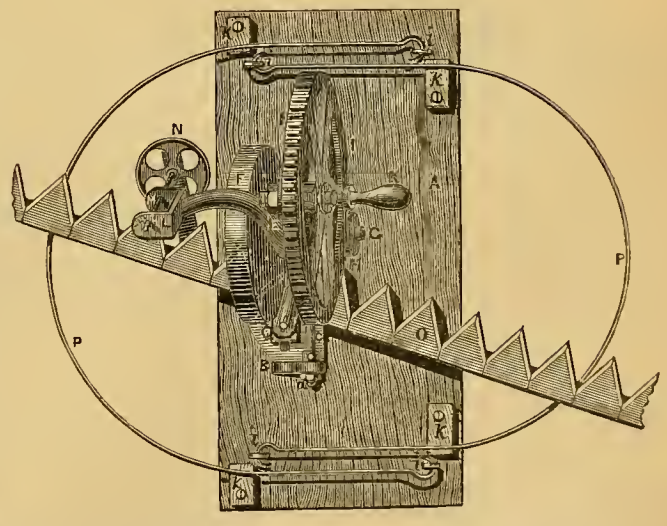
This invention has for its object the grinding or sharpening cutters of reaping and mowing machines in a more efficient and expeditious manner than heretofore, and consists of a peculiar combination and arrangement of adjustable grinding apparatus for that purpose. A

Fig. 1.




circular revolving grinding disc of stone, emery, or other grinding composition is employed, fixed upon a spindle, rotated by a winch handle or otherwise; which spindle is supported in a frame capable

Fig. 2.




of angular adjustment in a vertical plane, and of being fixed in its adjusted position by set screws or other convenient contrivance.

Fig. 1 of the annexed engravings is an end elevation of the machine; fig. 2 is a plan of the same. A represents the upper portion of a wooden or metal frame or standard upon which is bolted the cast-iron bracket B, carrying the whole of the mechanism. In the upright lugs of this bracket there is fitted a square rocking bar C, which has rounded journals formed at each end, and is tightened up in its bearings in the lugs by adjusting nuts *a*. Upon this bar is fitted, either directly or through the intervention of the slide D, the upright standard E, which is secured by a pinching screw *b* to the slide D, a slot *c* being made in the lower part of the standard through which the screw passes for the purpose of enabling the standard to be adjusted to any desired elevation, or to be lowered in proportion as the grinding stone or disc F wears away. *d* is a pinching screw which serves to fix the slide D in any desired position upon the rocking bar C. The stone or disc F, in lieu of being bevelled on the edge, is made parallel, or with its grinding surface at right angles to the side or face as shown. It is secured on to the end of the spindle G by a nut *e* or otherwise, and this spindle turns in bearings in the lower portion of the standard E. On the back end of the spindle G there is mounted a spur pinion H, which gears with the large spur driving-wheel I, mounted loosely upon a fixed stud centre in the upper part of the standard, and provided with a winch handle K for driving the same by hand. The upper front part of the standard carries a screw *f*, which enters a longitudinal slot in the adjustable bracket L mounted on the adjusting screw spindle M. By slacking the thumb nut *g* the screw *f* is free to slide along the slotted bracket L, and thus enables the standard E to be removed to any desired angle from the vertical, and be there fixed by tightening the thumb nut *g*. The lower end of the screw spindle M works freely in a socket *h*, in order to admit of its accommodating itself to any angle of the main standard, and it is provided with a hand-wheel N by which it is rotated when any nice adjustment of the angle of the stone or disc is required; the rotation of the screw spindle M tending to raise or lower the slotted piece or bracket I along the screwed portion of the spindle, and thereby altering the angle of the main standard. The knife, O, to be ground is supported in the machine in a horizontal position by the two adjustable rests P, hinged at *i* to the carrying frame or table, and adjustable in height by the swivel pieces *k*. Q is a swivel holder, shown in longitudinal section and plan at figures 3 and 4, for receiving the cutter bar. This holder consists of a pair of swivel jaws *l* mounted upon the slide *m*, which works along a slot in the metal bracket B towards and from the stone or disc. A bolt *n* passes through the slide *m* and through the swivel jaws and has a shoulder *o* formed upon it, against which shoulder the two swivel jaws are held by the tightening nut *p*, which at the same time causes them to grip and hold firmly the cutter bar. As the jaws are free to turn on the bolt *n*, the cutter bar can be readily turned or adjusted to any horizontal angle required to suit the angle of the knife edge; the vertical angle of the stone or disc being adjusted as before described to suit the level of the knife. By moving the slide *m* along its slot, the whole of the cutting edge from the root to the point will be progressively brought under the stone or disc during the grinding action.

Fig. 3.

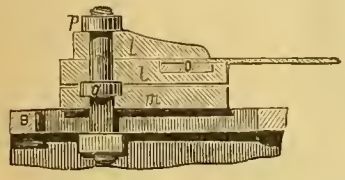
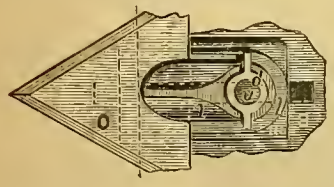


Fig. 4.



## LAWN MOWERS.

William Staples Boulton, *Rose Lane Iron Works, Norwich.*—*Patent dated March* 21, 1868.

This invention consists in placing the bearings of the axes of the knife-roller or cutting barrel, and of the intermediate wheel which gears with the wheel on the axis of the barrel, and also with the main driving wheel of lawn mowers, on a radial link which is concentric with and moves round the bearing of the main roller and driving wheel, so as to retain the intermediate wheel in proper gearing contact with the two wheels with which the same is in gear, whenever the axis of the cutting roller is raised or lowered as occasion may require. Also in attaching the main driving wheel to the axis of the roller or driving barrel by forming a conical bearing for the wheel on the axis of the driving barrel, and fixing such wheel and causing the same to be actuated or carried round with the axis of the driving barrel or roller, by tightening the main driving wheel on the conical bearing by means of a nut screwed on the said axes. This nut has an internal projecting conical surface, so that by loosening it the driving roller or barrel may if desired be left free to revolve loosely, without driving or actuating the main driving wheel or other wheels or parts of the said apparatus or machine.

Fig. 1 of the annexed engravings is a side elevation of the improved Lawn Mower with the wheel guard removed to show the improvements more clearly; and fig. 2 is a corresponding plan of one side showing the wheel guard in dotted lines. A represents one of the two side frames which carry the greater portion of the mechanism, and B is a portion of one of the two lever handles by which the machine is guided and controlled.

These handles are centred upon the axis of the main roller C, and carry the scraper D. This axis also carries one end of the side

FIG.1.

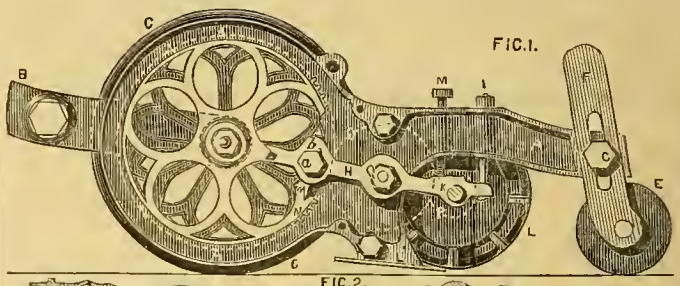
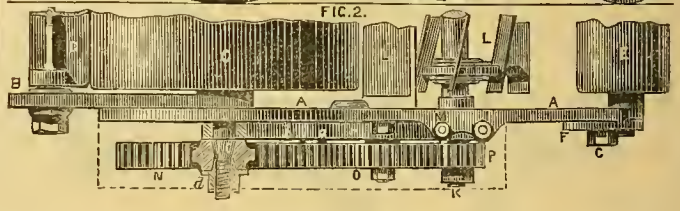


FIG.2.



frames A, the opposite or leading ends of which carry the front roller E, which is made adjustable in height by means of the slotted brackets F and tightening screw G. Against the outer face of each side frame A is arranged a radial link H, one end of which is hung freely on to the end of the axis of the main roller C or on a boss or projection on the frame A, concentric with the said axis, whilst its front end is suspended from the side frame by a bolt I passing vertically through a hole in the end of each link, which is thus supported upon the head of the bolt. The front ends of these links receive the journals of the spindle K of the knife roller L; and consequently, by suitably adjusting the nut on the top of the bolt I, the height of the front part of the links on each side of the machine and that of the knife roller may be varied according to the length of cut to which the machine is to be adjusted; the links during such adjustment turning slightly on the axis of the main roller, or on a boss or projection concentric therewith as a fulcrum. When properly adjusted the links are fixed by screwing down the set screws M, which work through the side frames and bear upon the upper surface of the ends of the links, thereby holding them perfectly secure and steady. A rotatory motion is imparted to the knife roller L, which works in contact with the straight blade L′ by means of the large spur wheel N mounted on the axis of the main roller; such wheel gearing into the intermediate wheel O, which again gears with the pinion P fast on the outer end of the spindle K of the knife roller. The intermediate wheel O revolves freely on a stud centre Q secured to the link H, the arrangement being repeated on each side of the machine. The links H are controlled in their radial motion by a bolt or screw *a*, which passes through a short curved slot *b* made in each link and enters the side frame A. In this way, by mounting the intermediate wheels O on the radial links

H, the train of gearing N, O, and P requisite for actuating the knife roller will always remain in action at whatever height the knife roller may be adjusted. In fig. 2 is shown an arrangement for readily tightening the main spur or driving wheel N upon its shaft, or allowing it to run loosely thereon as may be required. This consists in making that portion of the main driving shaft which receives the driving wheel N conical, as shown at *c*, the boss of the wheel being correspondingly bored about half-way through from the inner side. A similar conical bore is made from the outer side of the boss, and into this the conical projecting portion of the tightening nut *d* fits, which is screwed on to the end of the driving shaft. By simply tightening or slackening these nuts, the wheel N may be made fast or loose, according as the machine is required for rolling and cutting or for rolling only.

## PRESERVING ANIMAL MATTERS.

JOHN HENRY JOHNSON, 47 *Lincoln's Inn Fields, a communication from* C. E. RICHARDSON *and* G. T. WATERMAN, *Boston, U.S.—Patent dated April* 29, 1868.

THIS invention relates to a mode of preserving meat during seasons of the year when the temperature is very high, as well as in tropical climates. The said invention has for its object the overcoming an objection which has hitherto proved practically fatal to the pickling and preservation of beef, pork, and other meats during seasons of the year when the temperature is very high, and the rendering the process of preserving meat in brine or other liquid as safe and certain of success during the summer months and in tropical climates as during the winter.

Although great care may be observed in treating meat under high temperatures by the processes heretofore known, it is very liable to spoil in the brine, generally while it is in the first pickle, or before the salt can strike through and thoroughly permeate it.

The reason meat cannot be cured by salting during warm weather, or in hot countries, is that it is decomposed before the salt has time to permeate the vessels and pores, and so reach the centre of the mass. If the meat be cooled by artificial means down to the freezing point, but not absolutely frozen, the pores and vessels are not enlarged, and the meat may remain a long time in brine without absorbing more than a small quantity of the saline matter. But if the meat be preserved sweet throughout, so that the salt penetrates it, the process will be successful; this is accomplished as follows:—

The meat when fresh killed is cut into pieces of the usual size and shape, the bones remaining in their natural positions, and placed in a metallic vessel, care being taken to leave small openings between the contiguous pieces. This metallic vessel or freezer is provided with a suitable cover, and is placed within a larger vessel, which may be of wood: the space between the two vessels is now filled with any suitable freezing mixture; a mixture of pounded ice and common salt, as practised in the ordinary mode of making iced cream, will answer well in practice. The air is then excluded; the mixture of ice and salt produces a temperature equal to the zero of Fahrenheit, and the meat remains subject to this cooling process until it is frozen, every piece being frozen hard and solid at the centre as it is on the outside. Great care must be taken that the meat remains long enough in the inner vessel to become solidly frozen throughout. The effect of this freezing of the blood, water, serum, and other liquids contained in the flesh is to increase their bulk or volume, and distend all the pores and cavities within the meat. Whilst the pores are filled with ice and distended as above stated, the pieces of flesh are removed from the freezer and at once immersed in saturated brine. The frozen meat begins to thaw immediately, and the solution of salt that surrounds it is absorbed, and penetrates every part until the whole is completely impregnated. The brine is prepared by dissolving one bushel of salt in sufficient water to form a saturated solution, and adding thereto about half an ounce of saltpetre, with about one and a half pounds of sugar. The meat is then packed in barrels for use or transportation. With reference to the economy of this process it may be mentioned that the salt, which, mixed with the broken ice, forms the freezing mixture, is subsequently used for making the brine in which the meat is salted.

This process may be applied to the curing of fish and other animal matter, and solutions of other chemical substances may be used and varied in any required manner.

## PREPARATION OF VEGETABLE AND BITUMINOUS PRODUCTS.

JOSEPH ROGERS, *Islington.—Patent dated April* 23, 1868.

THIS invention relates to the utilisation and employment of certain residual products, such as cotton pitch obtained in and resulting from the treatment of vegetable oils, as cotton seed oil, as well as from the distillation and refining of crude mineral and bituminous products.

The invention consists, firstly, in the admixture of the residual products, or in such proportions as shall produce a material which shall possess such qualities as to render it applicable to the purposes required.

A mixture is employed consisting of about two parts by weight of the solid residuum resulting from the treatment of vegetable oils, such, for example, as the solid foots from cotton seed oil, or cotton pitch, and of about one part by weight of the fluid residuum or liquid foots resulting from the rectification of petroleum or of coal oil, so as to obtain a material capable of being employed for coating or impregnating woven fabrics, fibrous materials, ropes or yarns, and paper, or for the coating of iron and metallic work, ships' holds and bottoms, wood, and masonry. When the mixture has been subjected to the action of solvents, such as benzole or coal tar naphtha, a solution is obtained which may be employed as a covering or varnish for iron and metals, wood, masonry, textile and woven fabrics, fibrous materials, and paper.

Another part of the invention consists in the incorporation with the compound before mentioned of gutta-percha or india-rubber, or mixtures of the same, for the purpose of obtaining a material suitable for the covering of telegraphic wires, or for coating ships' bottoms or holds of vessels, iron or metal work, wood, masonry, paper, fibrous materials, and woven fabrics.

The proportions which have been found to give good results are about six parts by weight of the mixture or compound first named with about one part by weight of gutta-percha or of india-rubber, or with about a similar proportion of an equal mixture of the same; and when the material has been subjected to the action of suitable solvents, as benzole or coal tar naphtha, a solution is obtained which may be employed as a covering or varnish for the various purposes above named. The proportions may be varied according to the purpose to which the resulting compound is intended to be applied.

## LAW REPORTS.

ELECTRIC TELEGRAPHS.—NEWALL'S PROLONGATION. Before the Judicial Committee of the Privy Council—March 3rd. This was an application on the part of the petitioner for a prolongation of his patent for laying down electric telegraphs.

Mr. Grove, Q.C., and Mr. Aston were for the applicant; Mr. Manisty, Q.C., and Mr. Bidder for the Telegraph Company; Mr. Archibald and Mr. Macnamara were for the Crown.

A discussion arose as to the service of notice in opposition.

Sir. J. Colville said their Lordships, as there had been a misapprehension on the subject, would hold the notice to be valid, though they wished it to be understood that they did not intend to relax the rules which had been made under the Patent Act.

Mr. Grove opened the case, and proceeded to give *viva voce* evidence.

At a subsequent hearing the Court, after taking evidence, refused the petitioner's application.

SPOOLING OR WINDING MACHINES.—WREN ET AL. *v.* WEILD. Northern Circuit, before Mr. Justice Lush and a Special Jury—March 11. This was an action for an alleged slander of title to a patent in a spooling machine—a machine for winding thread on bobbins.

Mr. Webster, Q.C., Mr. Holker, Q.C., and Mr. Baylis appeared for the plaintiffs; and Mr. Quain, Q.C., and Mr. Aston appeared for the defendant.

The plaintiffs, it appeared, are machine manufacturers at Manchester who were the patentees of a machine invented by a person named Young, for spooling or winding cotton on bobbins, which was an improvement on prior machines, but which required an attendant to remove the filled bobbins, and which were manu-

faetured and sold by the plaintiffs. The defendant, who had been foreman in plaintiffs' works and other places, subsequently took out another patent in 1858, for a spooling machine, in which he combined all that was known before, and this machine was a self-acting machine from beginning to end, and was more elaborate and expensive than the plaintiffs'. Its merits were not denied, nor that the defendant had a good patent for his combination of other inventions, among which was the patent of the plaintiffs, which it was alleged he was improperly infringing. The defendant, however, claimed for the whole of his machine as a new invention, and wrote letters to persons who had purchased the plaintiffs' machine, warning them that the plaintiffs' machine was an infringement in part of his self-acting spooling machine, claiming a royalty of £25 per spindle, or £400 for a pair of machines of eight spindles each, and threatening proceedings to recover the royalty unless the plaintiffs' machines were returned to them or the royalty demanded paid. On the part of the plaintiffs it was alleged that the course pursued by the defendant had done them much injury in their business as the makers and vendors of their patent machine, and that the defendant knew that his statements were not correct, as he was well aware that the plaintiffs' machine had been, so far as it was an improvement on prior machines, embodied in his own combination for which he claimed his patent, and although dared and asked to bring his action to try the validity of his patent, the defendant had always declined to do so; but continuing his representations that the plaintiffs were infringing his patent, and claiming a royalty from all persons who bought the plaintiffs' machines, the plaintiffs had at last been driven to bring the present action.

His Lordship said the learned counsel must carry the case further than his opening or he should nonsuit him. He must establish that the defendant had falsely and maliciously impugned the plaintiffs' patent. If the defendant had a patent, and *bonâ fide* thought the plaintiffs' patent an infringement of it, his saying so was not maliciously slandering the plaintiffs' patent.

Mr. Webster—If the defendant *bonâ fide* thought the plaintiffs' patent an infringement of his own, why did he not bring his action ?

His Lordship—The defendant might answer, why do not the plaintiffs bring their *scire facias* to repeal his patent ?

Witnesses were called to prove the opening statement of the learned counsel, when, the evidence for the plaintiffs having been gone through,

His Lordship directed a nonsuit.

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Tatham et al. *v.* Dania.—Teasing Machines.—This was an action in the Nisi Prius Court at Manchester, tried March 12 and 13, before Mr. Justice Lush. The action was to recover damages for the infringement of the plaintiffs' patent. The defendant entered various pleas, denying the validity of the plaintiffs' patent, and also denying the infringement.

Mr. Hulker, Q.C., and Mr. Theodore Aston appeared for the plaintiffs; Mr. Manisty, Q.C., Mr. Edwards, and Dr. Parkhurst were for the defendant.

All the parties to this action are machine-makers at Rochdale. The patent which was the subject of this action was taken out in April 1867 by the plaintiffs, Messrs. Tatham and Heap. The invention related to machinery for teasing, breaking up, and opening cotton and woollen waste, cop bottoms, rags, and other fibrous or textile materials, and more especially to those machines containing two or more toothed cylinders or teasers, or two or more machines combined or connected to work together. In their completed specification the patentees thus described the invention :—

"Our invention consists in the application of rollers, or rollers and plates, or surfaces, or we employ the cages of such machines in combination with other rollers or surfaces, for the purpose of compressing and condensing the fibrous or textile material more effectually than heretofore on its passage from the preceding to the following toothed cylinder of such machines, by which means the fibrous and textile materials are delivered to the toothed or teasing cylinders in a more dense, solid, and suitable condition for being more perfectly torn and broken up or opened than can be done by any of the machines hitherto used for the purpose."

The plaintiffs alleged that shortly after they had begun to make machines under their patent, defendant copied them and made others, in which there was not even a colourable alteration, the only difference being that in the plaintiffs' machines the cylinder of the receptacle (for the broken material) between the cylinders was movable, while in the defendant's machine the same cylinder was fixed. When the plaintiffs saw some machines which had been fitted up by the defendant, they communicated with him. He denied the allegation of infringement, and insisted on his right to make the machines. There followed a long correspondence, which resulted in the bringing of this action, by which the plaintiffs sought to uphold their patent.

At the close of the plaintiffs' case, Mr. Manisty raised several objections to the form and effect of the plaintiffs' specification.

Mr. Justice Lush expressed an opinion against Mr. Manisty's views, but reserved leave to the learned counsel to argue them in the Court above.

The defence was that in several respects the machines which the plaintiffs had made were not new ; and Mr. Manisty said he would confine the attention of the jury to two or three cases, so that they might not be perplexed. He alleged that, however ignorant the plaintiffs might have been of the circumstance, yet they had been anticipated in several important particulars, and therefore could not claim their machine as a novelty.

One of the cases on which the counsel for the defendant relied was that of Mr. Dodd, a hard-waste spinner at Oldham, who, in consequence of the representations made to him by the factory inspector, had to alter his breaking-up machinery. He put in a pair of consolidating rollers, in the manner and under the conditions which were claimed by the plaintiffs in their specification. Mr. Dodd said that he worked his machinery until last year, when a fire took place at his mill. The material portion of one machine was produced in Court as a model. Mr. Dodd said that in 1867 Mr. Heap, one of the plaintiffs, came to his mill, saw the machine, and took off his coat to examine it. On a subsequent occasion both the plaintiffs called at his mill and examined the machine. They invited him to see the machine which they had built. Mr. Dodd went, and the moment he saw the machine he claimed it, and told the manager that it was his (Dodd's) invention. Evidence was called to prove that in April 1866 the two fluted rollers were made for Mr. Dodd's machine. There was a fault in the making which was immediately rectified, and the present state of the machine and the bill which was paid for the repairs were appealed to in corroboration of the defendant's and Mr. Dodd's allegations.

Mr. Justice Lush, in summing up the case to the jury, said he should not trouble them as to the construction of the specification, which was entirely a matter of law. The only question for their determination was whether the plaintiffs' invention was new—whether any part of what the plaintiffs claimed as their invention was in use or known before the date of the patent.

The jury, after a few minutes' deliberation, returned a verdict for the plaintiffs. The verdict was entered on all the issues for the plaintiffs, with nominal damages, 40*s*.

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## REVIEWS OF NEW BOOKS.

*A Practical Treatise on Heat, as applied to the Useful Arts, for Engineers, Architects, &c.* By Thomas Box. 1 vol. sm. 8vo. Spon, London, 1868.

This small volume does not belie its title ; it *is* a practical book, but we can scarcely say that it is a philosophical or a scientifically elegant one.

It has lost something of the aspect of this, and had its clearness impaired, by the inelegant symbols as printed in its formulæ, and by the way in which these have been forced into the midst of the text, in place of standing apart as in all the better class of mathematical works, whether English or French.

The goodness of the paper and type, and especially the excellent printing of the numerous tables, do not remove this confusion to the eye when first resting on most of the pages.

Wisely, it does not profess to teach thermotics, but rather to be a handy and copious magazine of cut and dry information as to the facts of heat and of its applications—a great subject, and requiring a master to deal with it effectively. Almost of necessity, however, Mr. Box commences with and gives us here and there "general principles" as well as facts, and in some respects we cannot deem his treatment of these as always satisfactory. In a word, as respects those hypotheses as to heat upon which its theory now rests in the hands of the advanced physicists both of Great Britain and the Continent, the work is scarcely up to the time. Perhaps this is best so for a work intended for the practical use of men who themselves do not generally know much about heat as a mode of motion, but yet we should have looked to have had passing notices of these newer views and of how they affect not only the nomenclature but the actual conceptions of the older views. Thus it would be well the reader should know and comprehend how different are the notions now connected with specific and latent heat to what were those of Black, or even Carnot.

The facts given are abundant, useful, and almost always, so far as we have had opportunity of examining, correctly given. There are a few repetitions of the old errors of others. Thus tables 15 and 16 are given as the results of experimental observation as to "the contraction of metals in casting." This is far from being the exact "fact," however. A casting in iron owes its final dimensions, not alone to the size of the wood pattern and to the coefficient of contraction of the cast iron, but to the latter and the size of the impression made in the sand or loam by the pattern, *i.e.* to the size of the pattern *plus* the "shake" necessary to free it in the sand and enable it to be "drawn." Again, the final size of an ingot of zinc cast in an iron mould (the last given in the table) is not that due to the size of the cold iron ingot mould and to the coefficient of contraction of the zinc, but to the expansion of the mould and the contraction of the zinc, &c. "The irregularities in the apparent contraction arise in great part," the author says, "from the practice of rapping the pattern in the sand," &c. This is true, but not the entire truth : if Mr. Box is aware of the fact, no hint is given of it, that no two sorts of cast iron have the same coefficient of contraction, nor any two pieces cast from the same sort or make which differ much in size ; and, indeed, we might add so many other disturbing conditions as to almost warrant our saying that the difference of size between casting and pattern is a matter

for the practical iron-founder, and can scarcely be properly viewed as amongst the facts of heat at all.

Mr. Fairbairn, as has been more than once pointed out, misinterpreted the results of his own experiments on the resistance of boiler flues exposed to pressure from the exterior, and drew general formulæ from them, which are not true of any such flue if of finite length and "*encastre*" at the ends, as such always must be in practice. Yet here we have the formulæ repeated, as though there were no doubt of their exactitude. There are a few deductions here and there which appear to us either incorrect or to be accepted with hesitation, *e.g.* those on the length of boilers after Table 37, p. 53, which seem to approach the direction of Mr. Chas. Wye Williams' strange notions derived from his own experiments on long and short boiler tubes; and analogous remarks might be made as to what follows table 87, page 177, deduced, it is stated, from a formula of Cauchy. With these objections we think we may, in mere justice to the author, say that we have exhausted all that we ought to express or have grounds for in the way of objection; and in conclusion we can commend Mr. Box's condensed and well-filled little volume to every mechanical and civil engineer, and to every architect whose "æsthetics" permit him to know accurately or to care anything about heat, as a handy book that they will do well to place upon their shelves and cannot fail to find frequently useful.

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*Sciography, or the Radial Projection of Shadows.* By R. Campbell Puckett, Ph.D., Head Master of the Bath School of Art. 1 vol. sm. 8vo., illustrated. Chapman & Hall, London, 1868.

Sciography is but one portion of the general applications of the laws of projection, commonly called perspective, itself but an application of descriptive geometry. It is, however, a highly important one, and this is a very good little book on the subject. Its title, to the geometer at least, seems a little misleading, as it appears to convey the notion at first that only shadows proceeding from a radiant point of light are treated of. The work is general, however, and "radial" only means that the limits of all shadows may be defined by rays. The introduction, by some slip of the pen, says: "the pupil, before attempting the *foregoing* problems, must be able to place objects in perspective." Except the above problem upon the title-page, we find no "foregoing" problem to the first page in the book. Sciography has been treated of largely and systematically by the Jesuits and by many of the older authors on perspective, as well as by Dr. Brooke Taylor, to whom as an author, Mr. Puckett alone refers. That a good knowledge of shadows is important to every artist, and especially to the architectural draughtsman, is undeniable; but those who know anything about the *inside* of the "get-up" of competition and like flashy architectural designs, know full well that false shadows are not always in these the result of ignorance, but in truth are intentional deceptions.

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*Report of the International Jury of the Maritime Exhibition of Havre of* 1868. 1 vol. 8vo.

This well-printed volume of Reports has been published both in London and Paris, and it is a slight but hopeful and pleasant sign of the times to find it to a great extent bilingual.

It will be a still more hopeful sign, however, when we can look forward to the time that long-continued amity and cordial interchange of commerce and of ideas shall have made the *élite* of even the middle and labouring classes of both nations bilingual; when French shall be to the ordinarily educated Englishman, and English to the correlative Frenchman, equally as mother tongues.

The medals and prizes of the Havre Exhibition really appear to have been awarded with care to justice and discrimination of merits, so far as one can judge by this volume.

Many of the jury reports are, as is always the case, flimsy enough; a few, however, much the contrary, and amongst these we particularly direct attention to that of Class V., section on River and Sea Fisheries, which comprises a large amount of very valuable and condensed information.

That is just such a result as should have been expected from the Havre Exhibition.

## FRENCH AND GERMAN TECHNICAL LITERATURE.

*Handbuch für specielle Eisenbahn-Technik &c.* Von E. Heusinger von Waldegg. Engleman, Leipzig, 1869. 8vo. illustrated.

The first part of this work, which is promised to be completed in four parts, has appeared, and it is probable that it will prove the most complete and encyclopædic work upon every branch of railway construction and plant, bringing down the subject to the existing date, that has yet appeared. This first part commences with an able sketch (not everywhere absolutely free from slight errors) by Von Weber, Director of State Railways at Dresden, of the rise, progress, and history of railways. The remainder treats of the substructure of the way (without dealing with bridges, viaducts, &c.), of the table, ballasting, permanent way, fastenings, &c., of which copious details of all the many varieties on the German, American, and other lines are given; and with the manufacture, verification, choice, &c. &c. of rails, including the Bessemer manufacture of steel rails.

There is a chapter of some interest upon the theoretic principles of the resistance of rails laid into way.

One excellent feature of this really fine work, which is well illustrated both with engraved plates and by woodcuts in the text, is a very complete bibliography and reference, at the end of each chapter, to all published papers upon its particular subject. These lists are chiefly of German works, but also contain those in most of the other European languages.

The book is wonderfully cheap, considering its illustrations. We cannot say we have met with anything perfectly new to us in this first part.

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*Die chemisch-technischen Mittheilungen des Jahres* 1867–68. Von Dr. L. Elsner. 1 vol. 8vo. Springer, Berlin, 1869.

This is the last and the sixteenth yearly volume of this useful *Jahresschrift*, giving account in brief articles, arranged in simple alphabetical order, of whatever marked improvements have been made in the past year in technical and applied chemistry.

The work is not as copious, nor as well known in England, as even Dr. Wagner's *Jahresbericht*, and that is little known enough.

It is a useful compilation, however, and creditable to the perseverance and zeal of the Editor, Dr. Elsner, who is the *Arkanist* (whether this be keeper of the secrets, or keeper of the records, we really do not know) of the Royal Porcelain Manufactory of Berlin.

Herr Dürre, whose work on Iron Founding (*Aphorismen &c.*) we noticed some time ago, has recently published an elaborate inaugural dissertation, delivered by him on the occasion of receiving his doctor's degree from the University of Göttingen, under the title of *Ueber die Constitution des Roheisens &c. &c.* Leipzig, 1868.

It is very full, systematic, learned, painstaking, and in some senses exhaustive; but we cannot say that we think it throws any new light upon the molecular constitution of iron, nor even quite sees the import of views long before the world on the subject, much less constructs a trustworthy general theory of the molecular constitution of all crude iron.—Ed.

## CORRESPONDENCE.

☞ We do not hold ourselves responsible for the views or statements of correspondents.

Langham Hotel, London,
*March* 8, 1869.

TO THE EDITOR OF THE PRACTICAL MECHANIC'S JOURNAL.

Sir,—I regret to be compelled to say that the explanation which you have appended to my letter to you of the 9th ult. does not in my judgment either "prove" or justify the assertion which you have put upon record that there are some parts of the narrative given in my new work relative to the use of liquid fuel by me thirty years ago, which "you happen to be in a position to prove are very essentially mis-stated."

As I never alleged that I "was the first introducer of liquid fuel for raising steam by the use of coal tar," I, of course, cannot consent to be made answerable for the accuracy of such imaginary statement. But, so far as I am aware, what I *did* say is correct in every particular. If, however, you are "in a position to prove" that the facts are "very essentially mis-stated," I submit that such mis-statement, if it exists, should be frankly pointed out. If, on the contrary, you find

that there is no inaccuracy in what I have said, it should, I submit, be as frankly stated that your criticism originated in misconception.

I am your obedient servant,
J. BOURNE.

Our reviewer did not impugn any fact in Mr. Bourne's personal history as given by himself of himself, in the passages pp. 5 and 6 of his Examples of Steam, &c. What he affirmed was that those passages tended to lead to the conclusion that Mr. Bourne was—practically, at least—the first introducer of liquid fuel; and anyone who reads them will, we apprehend, come to that conclusion from them, though it is quite true he does not "allege" he was so—even says "the plan did not originate with him," and in so far those passages were characterised as essentially mis-stated.

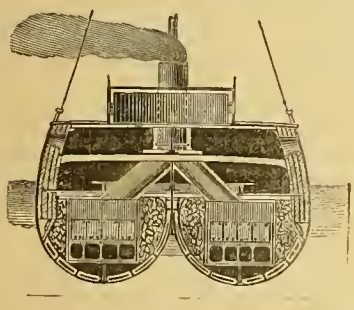
If Mr. Bourne disclaims his having so intended what he wrote—and, as we may read, his present letter, now alleges that he was *not* the first introducer practically of liquid fuel—we can only express our regret that he should have before so expressed himself as to have misled us, our opinion as to the tendency of the passages in question remaining unaltered.

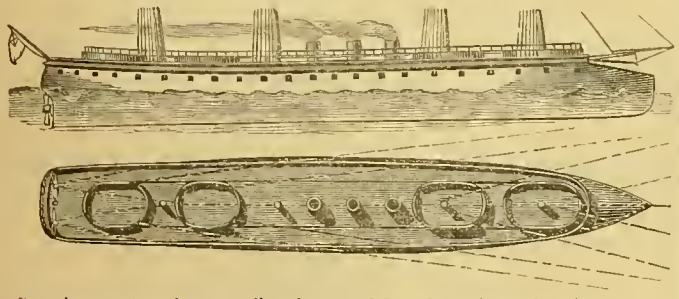
We decline to print any more upon the subject, unless indeed Mr. Bourne should still insist upon our reviewer having, however unwillingly, to state how and with whom the early use of coal tar fuel which led to its trial on board the "City of Londonderry" *did* originate.—Ed.

## SHIPS OF WAR.

TO THE EDITOR OF THE PRACTICAL MECHANIC'S JOURNAL.

Sir,—It appears to me that there is much room for improvement in the form of war vessels below the water-line. With ordinary U-shaped midship sections the rolling is very great, while the speed attained is very little. There is no doubt a war ship must have great carrying power; if made broad in the beam the scantling must be very strong, while with the ordinary form the structure is very weak. So as to resist the strain she is subjected to in the percussive mode of warfare, &c., I would propose a twin ship, propelled in a twin manner. Barrel-shaped vessels will, I consider, be always heavy rolling ships, while twin iron-clad ships of war will be freed from the "porpoise tribe:" but probably a twin vessel may receive a rather ugly name from the old salts; however, I will endeavour to construct the vessel so that it will be difficult to say what she may be. The outward form above water will just be like any ordinary ship, while the immersed section will be a twin structure fore and aft. The forefoot of each side will be cut away to about the level of the central keel, where the two sections meet at the centre line of the vessel. There will be only one bow, the central keel will run quite level, bent up to form the stem; and at the stern, from the point where the two sections meet, the keel will slope up aft to the water-line. Plating will be let into this bar keel, carried up to the lower deck. This will form the backbone of the ship; and at the bow this plating would be carried up to the top of the vessel, and otherwise stengthened to resist the force of impact while running. I consider for this mode of warfare the spur should merely be fitted to the bow and not form part of the vessel. Where the two





aft sections meet at the centre line, the central form forward must be quite parallel—just like ordinary twin boats, having a paddlewheel in the centre. The design is arranged for guns of the largest calibre; although twenty-two ports are shown on each side, I merely place them in, as I consider every portion of a ship of war should be made available. The fixed turrets on deck carry eight guns to fire right ahead. Trusting this slight novelty may merit space,

I am, Sir, yours truly,
13 Gladstone Street, St. George's Road. John G. Winton.

## FIELD ARTILLERY.

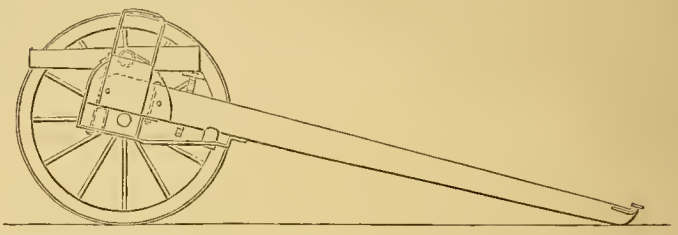
Sir,—A pamphlet lately published at Stockholm (C. E. Fritz, 1869), entitled "*Idées et Réflexions sur les Mouvements de la Tactique moderne*," from the pen of King Charles XV. of Sweden, contains some observations upon field-ordnance which appear worthy of notice.

Adverting to the unwieldiness of field artillery even in its most improved forms, and the opportunities which its long teams of draught cattle, its numerous ammunition waggons, &c. offer to the enemy's marksmen, the royal author advocates the adoption of a system of battalion guns, *four* being attached to each infantry battalion, which should be light enough to accompany and support the latter in *every* manœuvre.

These pieces should be as light and as simple in their construction as possible. They should be made of steel, and rifled; calibre not to exceed 1½ inch; weight of gun to be under 1¾ cwt. Shells should be used with them in preference to bullets, as being more likely to produce confusion in the enemy's ranks.

They should be breech-loading—the simpler the principle the better—and be capable of firing four or five rounds per minute. At a low angle, say of 3°, they should have a range of 750m. (800 yards about). Total weight of gun and carriage not to exceed 8½ cwt. Three or four gunners (on foot) and a pair of horses would suffice for each gun. In the event of the latter being killed, the piece could be easily manœuvred by men with ropes.

These details and the accompanying figure must be regarded in the light of *general suggestions only* as to the principles which should regulate the establishment of any such system.



The advantages to be derived from the adoption of the system are held to be:—

1. Enormous saving of transport and *matériel*.
2. That the fire of these pieces would often prove an invaluable adjunct to that of the battalion to which they are attached, under circumstances in which it would be impossible to employ field-pieces as now equipped.
3. That the pieces in each brigade or division could be readily massed for the production of any special effect, thus allowing the artillery reserves to be kept further out of range than at present.

"Care should be taken," it is added, "to avoid fostering a spirit of undue reliance upon these guns on the part of the infantry.

"Were they worked by infantry soldiers, wearing the uniform of the corps and mustering with it, the battalion would no doubt soon learn to regard guns as an integral, or perhaps even an indispensable portion of its equipments, the temporary absence of which would be fraught with danger.

"It would therefore be better that these pieces should be served by the Artillery, so as to keep up the old idea of the *co-operation* of the latter as a special arm." H. M. C.

Note.—There is nothing that can be said to be really new in the proposition as to the employment of light artillery conjointly with battalions of infantry in the foregoing extract from the Swedish royal pamphlet. Indeed, all that there is said, or that well could be said on the subject, was said as long ago as the days of Marshal Saxe, if not long even before then. In fact, the earlier notions on this subject were those which developed themselves into the systems of Flying or Horse Artillery of almost all the armies of Europe. Even steel field guns and "galloper carriages" are not novelties. One point, and the most important one of all, appears, so far as we gather from what precedes, to have escaped the royal author. The large range and precision of modern rifled small arms, and the rapidity of breech-loading, result in this—that if artillery is obliged to venture within their range the men become annihilated sometimes in a few minutes, and the guns are probably captured. This occurred more than once to the Austrians in 1866. A corresponding increase of range in rifled artillery has been obtained, and hence it obviously follows that the most effective and economical co-operative use of field artillery ought to be found in employing the guns while still out of usual and effective range of small arms.

But this again points to the advantage of rifled guns of large calibre, throwing *effective* shells, which is practically impossible with a gun of 1½-inch diameter of shell, and having as long ranges as the actualities of distant vision, &c. &c. will permit the good use of.

This being so, it is pretty obvious that the internal economy of modern armies henceforth points still to the artillery's constituting a distinct body, and to the manœuvres and co-operation of the field battery's being directed, not in reference to such small units as battalions, but having reference to and supporting regiments and brigades.

Whether it would be advantageous to possess swift-moving small-bored rifled artillery, not moving on wheels at all but so equipped as to be carried by horses, and in large numbers, manœuvred as and with cavalry, is another question, and one of great importance, which probably another ten years will solve affirmatively and with very decisive results.—Ed.

# PROCEEDINGS OF SCIENTIFIC SOCIETIES.

## THE ANNUAL CONVERSAZIONE OF THE ROYAL SOCIETY.

On Saturday evening the 6th March the President, General Sabine, held the first Conversazione of the year. It was well attended; and although the whole building at Burlington House is in progress of remodelling, preparatory to the Royal Society giving up its old quarters to the Royal Academy of Fine Arts, and entering its new abode being got ready for it on the adjoining ground, no inconvenience was felt in the arrangements, which were necessarily temporary. This was highly creditable to the exertions of Mr. Walter White, the assistant-secretary,

upon whom devolves most of the care of arranging these annual scientific reunions.

Amongst the objects collected in the rooms were many of great interest. Her Majesty the Queen forwarded a fine collection of chalk and pen drawings of Leonardo da Vinci. Those from natural vegetable objects were, many of them, of exquisite beauty, and might supply a lesson for those artists and architects who affirm the senseless dogma as universal—that all artificial ornament, if of natural forms, *must* consist of these *conventionalised, i. e.,* of natural form rendered *unnatural.*

Mr. Kirkaldy appeared to offer explanations on a large case of specimens of various metals, and other structural materials, broken in various ways by test loads in his machine at Southwark.

Mr. Sax had a large display of telegraphic apparatus, and illustrations of various applications.

Messrs. Sillar & Wigner showed results of their A B C sewage purificator and utilisator. This is so called from the initials of the three chief materials employed, viz. animal charcoal, blood, and clay. Mr. J. S. Horn, his improved safety lamp; Milroy's patent excavating apparatus for taking out sandy or "sloppy" stuff from the interior of coffer-dams, foundation cylinders, &c., without removing the water inside. This was shown by working model, and stated to have been very satisfactorily employed at the cylinders of the new Hutchinson Bridge at Glasgow.

Several new forms of galvanic or electro-magnetic apparatus for exploding blasts were shown.

Perhaps the greatest object of interest, if not the greatest novelty also, in the rooms was Mr. H. C. Sorby's exemplifications of the application of the spectrum microscope to mineralogy.

We transcribe his own account of this distributed on the occasion:—

"The following substances can be recognised in transparent minerals or blowpipe beads by means of the characteristic absorption bands seen in the spectra, even when they are much coloured by the oxides of iron, manganese, or nickel, viz. Didymium, Erbium,* Uranium, Cobalt, Chromium, Copper, Manganese, (when it occurs as permanganic acid,) a new earth, for which the name *Jargonia* is proposed, and another substance, perhaps also new, but not yet sufficiently studied.

"*Jargonia* is an earth closely allied to zirconia, existing in small quantity in zircons from various localities, but constituting the chief ingredient of some of the jargons from Ceylon. It is, however, distinguished from zirconia and all other known elementary substances by the following very remarkable properties. The natural silicate is almost, if not quite colourless, and yet it gives a spectrum which shows above a dozen narrow black lines, much more distinct than even those characteristic of salts of didymium. When melted with borax it gives a glassy bead, clear and colourless, both hot and cold, and no trace of absorption bands can be seen in the spectrum; but, if the borax bead be saturated at a high temperature, and flamed, so that it may be filled with crystals of borate of jargonia, the spectrum shows four distinct absorption bands, unlike those due to any other known substance.

"2. New applications of the Microscope to Blow-pipe Chemistry.

"Of these there are two chief divisions. In one method the substance is fused with borax or microcosmic salt, so as to give a clear bead, and the spectrum is examined by means of the spectrum eye-piece. In the other method the saturated borax bead is kept hot over the lamp, so that crystals may be deposited in it. By using a microscope many elements may then be easily distinguished by the form of the crystals, which are often of extreme beauty. When, however, much mixed, or combined with silica or other acids, as in natural minerals, it is often requisite to add various re-agents: as phosphate of soda, microcosmic salt, boric, tungstic, molybdic, and titanic acids. These give rise to characteristic crystalline deposits; and we may thus distinguish lime, magnesia, baryta and strontia, even when combined with silica; and can detect magnesia when mixed with several times its weight of lime in impure limestone, &c.

"Examples of this method:—

"1. *Sphene* melted with borax does not deposit crystals; but the addition of boric acid sets free the titanic acid, easily recognised by the form of the crystals. Diluting the bead with more borax, so as to retain the titanic acid in solution, phosphate of soda causes the deposit of crystals of phosphate of lime.

"2. *Fergusonite,* from Greenland, shows the spectrum of didymium, and from Ytterby that of erbium. When fused with borax it deposits crystals of columbic acid; and after diluting with borax to prevent this, the addition of phosphate of soda produces crystals of phosphate of yttria.

"3. *Gadolinite,* from Ytterby, melted with borax, gives a spectrum indicating the presence of didymium and erbium; and when kept hot it deposits the characteristic crystals of borate of yttria."

There can be little doubt but that this method will come to play an important part ere long in aiding the qualitative determination of inorganic substances by the blowpipe, and even as a common laboratory testing tool.—Ed.

The Master of the Mint, Professor Graham, exhibited a remarkable example of the expansion of palladium by hydrogen in the form of a compound ribbon of that metal coiled up like a spring, and placed as the negative electrode of a battery decomposing water. The hydrogen is absorbed by the palladium, and the expansion of the metal is indicated by the uncoiling of the spring. If the current be reversed, and oxygen thrown on the ribbon, the hydrogen is removed, and the spring retracts. These experiments were prepared with great care by Mr. Roberts. The structure of the wire was also shown by the microscope and by drawings.

The specimens of beet-root sugar made in this country deservedly claim attention. They were produced by Mr. Duncan, of Mincing Lane, who has built large works at Lavenham, in Suffolk, for the purpose of carrying on this manufacture. The illustrative series commenced with some fine white and rose-coloured Silesian beet-roots grown by the Suffolk farmers. Last year they raised 800 tons; this year they expect to produce 4,000 tons, and the price delivered at the works is £1 per ton. The pulp after the expression of the juice finds a ready market as a cattle feed. The sample of sugar shown was excellent in colour and quality, and large in the grain. Mr. Bidder's hydraulic coal-breaking machine, a new invention, was also illustrated by model. A description of this machine was given in our last, p. 354.

The other mechanical and practical inventions deserving mention were the magneto-exploder of Breguet; an improved pneumatic electric lamp by Mr. Wigner; a fine series of steel and iron testings, including a set of examples of metal produced by Heaton's process, by Mr. Kirkaldy; telegraph apparatus, by Mr. Holmes, by the Silvertown Company, and Wilder's A B C apparatus, by Mr. Sax; Norwegian heat-retaining and cooking apparatus and pocket filters, by Messrs. Silver; and two magneto-electric machines, by Mr. Wilde, worked by one winch and two straps, without any connecting gear between the armatures, to show the effect of the magneto-electric current in controlling and rendering synchronous the rotations of the armatures of a number of electro-magnetic induction machines. Mr. Gisborne exhibited his mechanical repeating signals for ships as fitted on board the König Wilhelm. The utilisable products of the sewage of Leicester, Tottenham, and Leamington, also were shown.

* Erbium of Bunsen—Delafontaine's Terbium.

## ROYAL INSTITUTION.

Dr. Odling, F.R.S., delivered the seventh of his course of lectures on Hydrogen and its Analogues, February 20th. On this occasion he gave attention principally to the combinations of hydrogen. He burnt a jet of pure hydrogen in a jar of chlorine gas; the flame increased in brilliancy, and the product of combustion was hydrochloric acid gas. Next, he filled an inverted Florence flask with hydrogen, and, after lighting the gas at the mouth of the flask, he lowered it over a jet of chlorine issuing from a fine glass tube; the chlorine was then seen to burn inside the flask of hydrogen. Both the foregoing experiments show the surface nature of chemical action, for all flames are nothing but shells, the luminous layer being where the two gases come into contact; it does not matter which gas forms the jet, or which forms the exterior envelope, as in any case the flame will be produced. A jet of hydrogen was next burnt in a large glass jar full of common air, and the union of the hydrogen with oxygen of the air produced water-gas or steam, which was condensed upon the cold sides of the large glass vessel. The same experiment was shown with pure oxygen in the place of common air, which is oxygen diluted with nitrogen. Dr. Odling afterwards filled a glass globe with a running stream of coal gas, and, by means of a little piece of tube piercing the bottom of the globe, a jet of common air was admitted into the sphere; this jet was then lighted, so that the common air was seen burning in the middle of the atmosphere of coal gas, this being a reversal of the household experiment wherein jets of coal gas are made to burn in common air. After showing how hydrogen will decompose vapour of tetrachloride of carbon, under the action of heat, by uniting with the chlorine to form hydrochloric acid, the lecturer showed how the ignition of a mixture of hydrogen with nitrous oxide or laughing gas will set up decomposition, resulting in oxide of hydrogen and nitrogen gas. Dr. Odling next took a jar of chlorine gas, and shook up in its interior a little of the most volatile spirit which can be distilled from petroleum; when this mixture of gas and vapour was ignited the hydrogen united with the chlorine, producing at the same time a deep red light and volumes of black smoke. Another very neat experiment exhibited by Dr. Odling was the combustion of oxygen and ammonia. Some strong liquid ammonia was placed in the bottom of a glass flask, and a stream of oxygen was directed upon the surface of the liquid by means of a glass tube passing down the neck of the bottle, till it just touched the surface of the ammoniacal solution. Upon dropping a light into the flask, the mixed oxygen and ammoniacal gases caught fire, and burnt brilliantly upon the surface of the liquid. Substances rich in hydrogen and carbon, such as wood and tallow, will usually burn vividly in oxygen or common air; but when the exterior gas is highly hydrogenous, the substances easy to burn therein must usually be rich in oxygen. Chlorate of potash, which is very rich in oxygen, is incombustible in common air; but when Dr. Odling made some chlorate of potash red-hot in a metal spoon and immersed it in a glass jar filled with coal gas, the chlorate of potash burnt away brilliantly.

## THE INSTITUTION OF CIVIL ENGINEERS.

January 26, 1869.—The Paper read was "Description of the New Ferry and the New Brighton Piers and Landing Stages, on the River Mersey, near Liverpool," by Mr. Henry Hooper, Assoc. Inst. C.E.

The ferry accommodation of the River Mersey having been briefly noticed, it was stated that in, order to provide a means of communication by water between the central and the southern portions of Liverpool and New Ferry on the opposite shore, the Mersey River Steamboat Company was originated, to run steamers from the Prince's Stage to the south end of the borough, and thence across the estuary to New Ferry.

This necessitated the erection of a pier, with landing stage and connecting bridge, at New Ferry, which was constructed from the designs of Mr. Brunlees, M. Inst. C.E., by Messrs. W. and J. Galloway and Sons, under the superintendence of the author. The pier consisted of fourteen spans, each 58 feet in the clear. It was formed of three lines of wrought-iron girders, placed 9 feet apart from centre to centre, and resting on cast-iron columns. The openings were arranged in three groups—the first from the retaining wall towards the river, comprising five bays; then two rows of columns; next, four bays; and again two rows of columns; and lastly, five bays, terminated by a platform, 18 feet by 16 feet, supported on a cluster of eighteen columns and piles. The girders were each 60 feet in length, 4 feet 9 inches in depth, and of the ordinary lattice form, footways of Memel planking being carried on the bottom flanges. The two footways were each 8 feet 4

inches in width, and were assigned respectively to the traffic passing in opposite directions. The top member of the girder was composed of two half-round bulb irons, forming, when riveted together through the flanges, a tube of 8 inches external diameter. The two outside girders were each calculated to bear a load of 120 lbs. per superficial foot of platform, and the centre girder was nearly twice the strength of the others. The supporting columns were 12 inches external diameter, the metal being three-quarters of an inch in thickness. They were generally cast in lengths of 10 feet, and were connected together by flange joints, excepting the junction of the columns with the piles, which was of a socket form. The piles were cast in variable lengths, to suit the contour of the ground ; they were furnished with one turn of a screw at the bottom, 2 feet 6 inches in diameter, the metal being $1\frac{1}{4}$ inch in thickness at the root, and the top of each pile was of a plain spigot form. The piles were screwed down to depths of from 6 feet to 10 feet by means of capstans.

The outer edge of the platform at the head of the pier formed a bearing for the movable joint at the upper end of the bridge, connecting the pier with the floating stage. This joint allowed a horizontal and vertical motion of the bridge, and consisted of a strong wrought-iron girder, having a radial motion round a steel pin, 4 inches in diameter, fixed to part of the framework on the top of the columns.

The vertical motion was obtained by means of a hinge under each girder of the bridge, composed of a wrought-iron forging, bolted to a rotating girder, and a steel pin, $2\frac{1}{2}$ inches in diameter, passed through it and the two forged straps riveted round the end of the bridge. The under side of the rotating girder immediately beneath these hinges was supplied with two sheaves or rollers, bearing on segments fixed to the heads of the columns. The bridge was 158 feet in length, and was formed of two bowstring girders, on the lattice principle, 10 feet in depth at the centre, and placed 9 feet 8 inches apart. These girders were kept in place at the bottom by T irons, and at the top by an arch of wrought iron. The lower end of the bridge was suspended by chains from a wrought-iron cradle fixed on the floating stage. This was considered necessary, to reduce the strain on the pier and bridge, caused by the rolling of the stage, and was found to answer very well. The platform of the pier was 12 feet above high water of ordinary spring tides, and 7 feet above an extraordinary tide of 21 feet.

The floating stage was 100 feet in length by 22 feet in breadth, tapering for a length of 19 feet to 19 feet at each end. A spur, 22 feet by 11 feet, projected at the back under the bridge. The pontoon was 7 feet 3 inches in depth, and the sides had a batter inwards of 1 foot. It was built of ribs of T iron, and was divided into five compartments by four watertight bulkheads. To increase its stiffness there was a longitudinal bulkhead along the centre of the pontoon, and smaller bulkheads under the cradle supporting the bridge. The deck and appurtenances were of the usual description. The stage was moored by four chains, two at each end of the pontoon. Each chain was 50 fathoms in length, and at right angles to the adjoining one, the end of each being secured to an anchor with one fluke. Provision was made for taking in the slack of the chains by two sets of gearing fixed on the stage, one at each end. The pontoon drew about 2 feet of water, and at low water of spring tides there was never less than from 7 to 8 feet of water at the front of the stage.

The dimensions of the various parts of the structure were given in detail ; and with regard to the expenditure upon the works, it appeared that the approaches cost £1,063, the pier (including the bridge) £7,740, and the stage £2,674, making a total of £11,477.

The design for the New Brighton pier and landing stage was of a similar character to that of the New Ferry pier, and was likewise furnished by Mr. Brunlees, the original contractors being Messrs. Rothwell & Co., but the works were finally completed by Messrs. Bowdler & Chaffer.

The pier consisted of three lines of wrought-iron girders, each 60 feet in length, the number of bays or spans being twelve, divided into three groups of four spans each, by two intermediate rows of columns. The enlarged platform at the river end of the pier was 33 feet 6 inches by 16 feet, and was supported by short wrought-iron girders, resting upon a cluster of twenty vertical and thirteen raking cast-iron columns, 12 inches external diameter, the metal being three-quarters of an inch thick. The screw piles were 2 feet 6 inches in diameter, and had a pitch of 7 inches. They passed through variable depths of from 5 feet to 8 feet of sand and gravel to the surface of the rock underneath. The width of the pier from centre to centre of the outside girders was 21 feet 4 inches ; the centre girder dividing the platform into two footways, each 10 feet in the clear, the girders forming the parapets.

The bridge connecting the pier and stage was 160 feet in length ; the two girders were 11 feet apart from centre to centre, leaving a clear footway of 10 feet 3 inches. The upper end of the bridge had a similar motion, and the lower end was hung by chains from a wrought-iron cradle on the same principle as that at New Ferry.

The floating stage was 200 feet in length by 30 feet in breadth, and consisted of a series of 12 pontoons, connected by three lines of lattice girders and two lines of box keelsons. The end pontoons were pointed, so as to act as cutwaters, and were each 29 feet by 18 feet ; the ten intermediate pontoons were 29 feet by 11 feet 6 inches, and the depth of all the pontoons was 6 feet 3 inches. The stage was finished in the usual manner, and was provided with all necessary fittings.

The dimensions of the various parts were given in detail, and in conclusion it was stated that the total cost of the pier, bridge, stage, and subsidiary works had amounted to £23,906.

February 16, 1869.—The Paper read was "On the Lagoons and Marshes of certain parts of the shores of the Mediterranean," by Professor D. T. Ansted, F.R.S.

The author commenced by alluding to the relations of physical geography and geology to engineering, and proceeded to describe the state of the Rhone, its delta, and the tract called the Camargue. He remarked that the actual delta was limited to the west by the stream of the Vidourle, and to the east by the Crau; its extreme breadth being 40 miles, and its area 180,000 acres ; and he noticed that while the main stream had gradually been shifting towards the east, the pseudo-deltaic formations subordinate to it had been rapidly advancing towards the west and south. He then alluded to the condition of the Rhone current, and the evidence that the delta had advanced outwards towards the sea within the historic period by a distance measured by miles. The mode of formation of the delta was described as follows :—Sand, drifted by marine currents from the south-east from beyond the mouth of the Rhone, formed mounds or dunes at places where fresh water, running down from the land, met the salt water. The dunes increased in number along a line parallel to the shore, till they formed an imperfect border to brackish-water lagoons. During summer the dunes became connected, and in the rainy season breaches were caused by the sea. At length a complete barrier was effected, and a nearly fresh-water lagoon was formed. The same work was then repeated, and the lagoon was filled up more or less completely in the course of time by warping, so that a permanent addition was made to the land. The largest lagoon of the delta (that of Valcares) was next described. It covered 25,000 acres, and was protected by an artificial sand dyke, $16\frac{1}{2}$ miles long, completed in 1857. The other works executed, with the exception of some locks and canals to keep open channels to the sea, were very slight.

Details were next given of the great system of lagoons extending beyond the true delta of the Rhone to the Cape of Agde, a distance of nearly 40 miles, which the author believed to be of no great geological antiquity. Beyond the delta the district consisted at first of the tertiary deposits, near Montpellier, then of the jurassic formations of the ridge of the Gardéole, and finally, of the basaltic rocks, continued from Central France, and which terminated at the Cape of Agde.

The lagoon of Mauguio, the first beyond the Vidourle, had an area of 8,000 acres ; its greatest depth was 4 feet 7 inches, and the level of the water was 8 inches below the Mediterranean in summer. It communicated with the sea by only one opening, and was separated from it by a sandbank at first $1\frac{1}{2}$ mile wide, gradually narrowing to 500 yards or 600 yards. Towards the land were extensive marshes, and all the villages around were very unhealthy. It received the drainage of about 78 square miles, by a number of streams, the longest of which was about 13 miles. This lagoon was nearly separated from the next (the lagoon of Pérols) by a tongue of land, beyond which came the drainage of a stream (the Lez). The lagoon of Pérols, and the next in order, that of Grec, covered about 3,300 acres, of which about 2,425 were under water, the rest being marsh. The maximum depth of water was only 33 inches below the summer water-level, which was 7 inches below the Mediterranean. The marshes around were about 10 inches above the water level. These lagoons received little water from the land immediately around. They had been fed almost entirely from the drainage area of the Lez, now conducted by canals direct to the sea. The drainage area of the Lez was 125 square miles, but the effect of rain was rapid and considerable, owing to the form of the ground and the extremely heavy showers that sometimes fell. There were three lagoons between that of Grec and the great lagoon of Thau, the total water area being 11,280 acres. They received the drainage of about 33 square miles of country, and the physical conditions accounted for the lagoons. The lagoon of Thau covered 20,000 acres, its only natural outlet being at the extreme south. It received the drainage of about 120 square miles of country. The works projected for the improvement of the sanitary condition of the coast, and the recovery of the marsh lands, were next alluded to, and were stated to be on the whole satisfactory.

Attention was then directed to the lagoons on the east coast of Corsica. These were derived from the detritus brought down by the rivers from the mountains. The Golo was the chief river, and the lagoon of Biguglia the largest lagoon. It extended north of the Golo, its length being $7\frac{3}{4}$ miles, and the average breadth for 6 miles 1,000 yards. Beyond this, to the north, was a narrow neck of water communicating with the sea. The total water area was 4,750 acres ; the maximum depth was 4 feet 6 inches, and the mean depth $33\frac{1}{2}$ inches. It was separated from the sea by a sandbank, 900 yards wide near the Golo and 400 yards at the other end. During storms the waves washed over it at two points. The water was sometimes fresh and sometimes salt. The drainage area supplying water to the lagoon was 70 square miles, but it was made up of three parts—one between the Golo and the river Bevinco, the principal feeder ; the next, the drainage area of the Bevinco ; and the other, a small space of ground supplying water to the neck beyond the Bevinco. The author then explained the history of the lagoon, and pointed out that by separating the district, and conducting the waters of the Bevinco to the sea, the condition of the larger part (about 4,000 acres) was not at all unfavourable for complete drainage. He compared the case of the Bevinco to that of the Lez, on the coast of Languedoc; and pointed out that there was historical evidence rendering it probable that the Bevinco had only recently added its waters to the lagoon of the Biguglia, owing to the gradual advance of the dunes that enclosed the latter ; and that the coast was comparatively healthy, and was inhabited, before this event took place. He mentioned that the case of the other lagoons along the coast was similar, generally, to that of the Biguglia; but that each needed separate consideration, according to the physical geography of the district.

Rainfall statistics both of the coast of Languedoc and that of Corsica were then given, from which it appeared that the average rainfall on the coast of France, near the delta of the Rhone, was about 36 inches, and of the coast of Corsica not more than 24 inches for the years of observation. The extremes were, however, very great, and the mean annual fall was of little value for practical work. The seasonal falls were also given, and some particulars of heavy rain on both coasts.

The author concluded with the following summary of the practical bearing of the facts adduced :—

First. That the malarious lagoons and marshes, of which there were so many examples on various shores, were the result of the interception of waters coming off small tracts of land, or of small and torrential streams, by banks of drifted sand and mud, proceeding from larger rivers, carrying out to some distance large quantities of detritus, which was distributed by marine currents.

Secondly. That a study of the existing physical gengraphy of each district affected by malaria, combined with a knowledge of its geology, was sufficient to explain the conditions, and to determine the history of the operations that had terminated in the formation of the malarious marshes and lagoons.

Thirdly. That the removal of malaria, whether to be effected by complete drainage or by partial drainage, accompanied by the keeping certain lagoons in free communication with the sea, could only be hoped for by engineering operations based on the special history of the case under consideration, as determined by a knowledge of the physical geography and geology of the district.

Fourthly. That, in certain cases where small torrential streams had been kept back from the sea by the rapid accumulation of drifted sand, drainage of the marshes and lagoons might be rendered comparatively easy by keeping open a permanent channel for such streams.

Fifthly. That the principle of breaking up the drainage areas supplying water to the lagoons into smaller areas, each of which admitted of separate treatment, being suggested by the history of lagoons generally, was the principle which should be adopted in all cases where sanitary improvement was called for, and would generally be found advantageous in an economic sense.

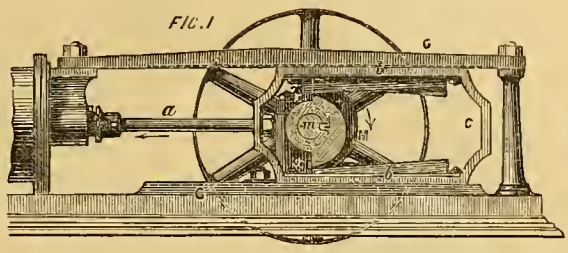
## LONDON ASSOCIATION OF FOREMEN ENGINEERS.

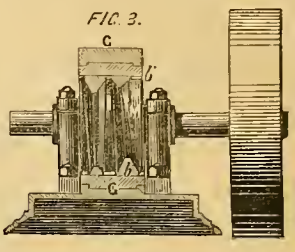
On the 12th Feb. the sixteenth anniversary of the above Association was celebrated by a dinner at the City Terminus Hotel, Cannon Street. Joshua Field, Esq., C.E., occupied the chair, and R. Moreland, Esq., C.E., the vice-chair. The members and guests numbered nearly 200, and amongst the company present we observed General Lefroy, R.A., F.R.S., E. J. Reed, Esq., C.B., Joseph Whitworth, Esq., LL.D., F.R.S., W. Todd, Esq., C.E., Robert Mallet, Esq., C.E., F.R.S., Frank Ives Scudamore, Esq., of the Post Office, Henry J. Slack, Esq., F.G.S., Captain Rintoul, Edward R. Allfrey, Esq., C.E., Edward Humphrys, Esq., C.E., John Penn, jun., Esq., Charles Seidler, Esq., John R. Ravenhill, Esq., C.E., James Robertson, Esq., V. Pendred, Esq., J. Waller, Esq., J. Newton, Esq. (President of the Association), Passmore Edwards, Esq., Dr. Fennell, &c. James M. Napier, Esq., and John Penn, Esq., C.E., F.R.S., were absent from illness, but each sent a cheque for twenty guineas.

After the usual loyal toasts, the Chairman proposed that of the "Army, Navy, Militia, and Volunteers," which was responded to by General Lefroy, and Mr. E. J. Reed, C.B., the Chief Constructor of the Navy; Captain Moncrieff, who was also to have responded, being absent from illness. The report of the secretary, Mr. D. Walker, was then read, after which "Prosperity to the Association" was proposed by the Chairman, who coupled with the toast the name of its indefatigable president, Mr. Joseph Newton. Mr. Newton, in responding, very happily referred to the relations between the foremen engineers and their employers, and pointed out the good feeling and perfect understanding which existed between them. He also referred to the satisfactory condition of the Association, which was due in some respects to the employers as well as to the members themselves. The following is an extract from the sixteenth annual report, which was read by the secretary upon the occasion. That document records a continuance of the steady progress of former years; while the established features of the Association have worked steadily and well, new ground has been opened and fresh enterprise entered upon. Ten ordinary and seven honorary members have been added during the year, and two deaths have occurred; the effective number being 104 ordinary and 67 honorary members. The income of the past year was £221 10*s.* 6*d.*, whilst the expenditure was £261 14*s.* 9*d.* These figures show the expenditure to have been £40 4*s.* 3*d.* in excess of the income, the effect of the severe commercial panic, which necessitated payments to a number of unemployed members. The present value of ordinary funds invested in stock Three per Cent. Consols is £364 4*s.* 2*d.*; there is in the savings bank the sum of £65, and in the treasurer's hands £4 18*s.* 9*d.*, making a total of £434 2*s.* 11*d.* A widow and orphans' fund was established in the early part of the past year, which has not progressed quite so satisfactorily as could have been wished. To the superannuation fund there was subscribed by the various gentlemen present a total of £95 14*s.*, which, with subscriptions previously acknowledged, makes a grand total of £1,044 16*s.* 2*d.* We are glad to learn that this fund, with the accumulating interest, remains intact, no application having yet been made for the benefit it provides, although, when applicants do come forward, the amount will go but a short way in providing for them, as the interest—the only part that will be appropriated—would suffice for but two at the rate laid down. The interest in the proceedings of the monthly meetings—of which abstracts appear in our columns—continues to increase, and they are found to improve in usefulness as the papers become more practical.

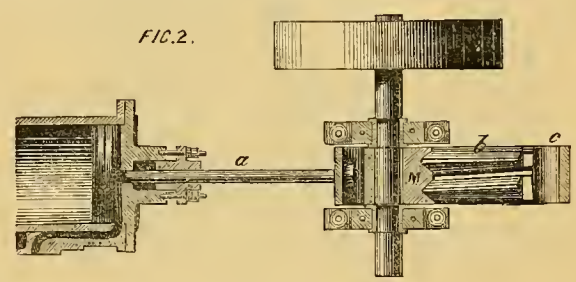
# MONTHLY NOTES.

Lhonoré's System of Converting Reciprocating Rectilineal into Continuous Rotatory Motion.*—The annexed engravings illustrate a method of converting a reciprocating into a circular motion recently patented by M. J. E. Lhonoré, of Havre, which has the merit of simplicity. It consists in keying on to the driving shaft a half boss, the circumferential surface of which corresponds to the direction of the rectilineal motion. This half boss has two semi-annular grooves formed on its periphery, of a wedge shape in cross section, which gear with corresponding longitudinal projections formed on the reciprocating slide. Two of such projections are disposed at the top, and two at the bottom of the slide, in order to effect the continuity of the rotatory motion. This method of conversion has the peculiarity that it acts on the shaft not only with the largest lever, but also that it reduces considerably the length required when connecting rods are employed. The engravings, of which fig. 1 is an elevation, fig. 2 a horizontal section, and fig. 3 a cross section, show the system applied to the piston of a prime mover, although in our opinion it may be employed with greater advantage in other mechanical combinations. The piston-rod *a* is attached to the slide C, which works between the guides G, disposed in the ordinary manner, although above and beneath the driving



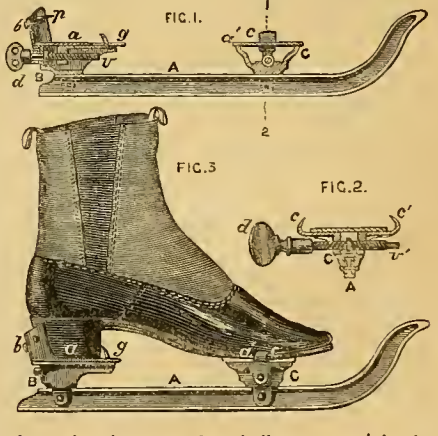




shaft *m*, in which rotatory motion is to be transmitted. In the interior of the slide are fixed projections *b b'* of a conical form longitudinally, and of a corresponding form in cross section to that of the grooves. They are placed inversely, the narrow part of one projection being at the side of the larger part of the other: their exact position may be regulated by adjusting screws or otherwise. M is the half boss fast on the driving shaft, and provided with grooves into which the projections *b b'* gear. It will now be seen that if the piston is set in motion in the direction of the arrow, the lower projections *b*, following the motion of the slide




C, act on the boss M, and cause it to rotate, and with it the shaft *m* in the direction of the arrow. When the slide has arrived at the end of its stroke, the point *x* of the boss comes in contact with the point *x'* of the upper projection *b'*, by which the reverse motion of the piston is caused to continue the rotatory motion of the shaft, which completes one revolution. This method of converting motion is attended with some difficulty, in so far as relates to the construction of the boss and the adjustment of the projections; but it is exceedingly simple, and capable of working in either direction, in order to reverse at will the direction or rotation of the shaft.

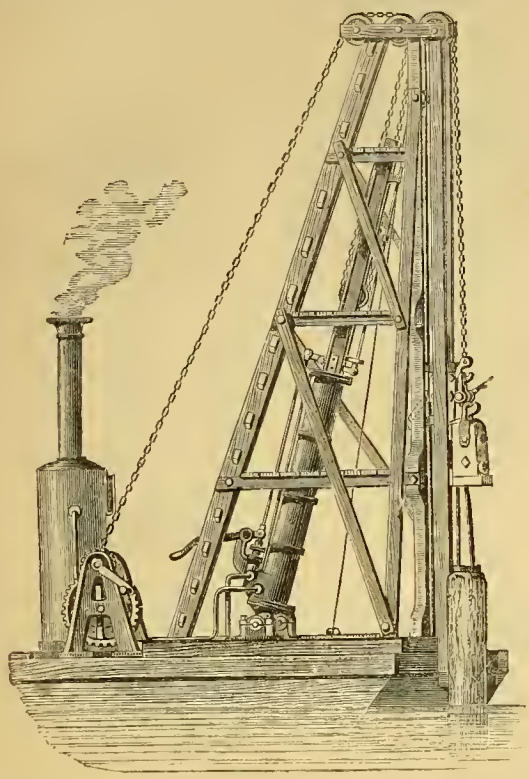
Stotz' Skates.—Mr. A. Stotz, of Stuttgart, manufacturer, has recently patented a novel system of skates, by which they may be firmly and rapidly attached to the boot without the use of straps. Fig. 1 is a longitudinal section of the apparatus, which is applied to the blade of the skate in order to secure it to the boot; fig. 2 a transverse section of the same taken along the line 1-2; and fig. 3 shows the skate attached to the boot. The blade A carries supports B and C, of cast-iron or other suitable metal, which are provided with plates *a a'*, on which the sole and heel respectively rest; the heel is surrounded at the back by a flange *b*, provided with points *p*, and formed in one with the plate *a*. A screw *v*, passing through the support B, screws into a nut formed on the clasp *g*, and a similar screw *v'*, in the bearing C, actuates two clasps *c c'*; this screw is turned by the key *d*, and is right and left-handed. It will be understood that, by screwing up the screw *v*, the clasp *g* is caused to grip the heel, and the points *p* penetrate at the same time; and similarly, by turning the screw *v*, the clasps *c c'* are caused to grip the sole, and thus the skate is firmly secured to the boot. It will thus be seen that by this method the skates may be withdrawn and replaced with the greatest facility, whilst dispensing with the use of straps and other apparatus, by the breakage of which accidents are frequently occasioned.




Chrétien's Direct-Acting Steam Pile-Driver.—The annexed engraving illustrates a direct-acting steam pile-driver recently introduced by Mr. Chrétien,

* Translated from *Le Génie industriel.*

manufacturer of cranes and steam-lifting apparatus, Paris, which is very similar in principle to the cranes of the same maker. Its construction will be readily understood by a reference to the engraving, without a lengthened description. The workman in charge of the pile-driver has but to move a single lever in order to effect a blow on the pile; as the pile is driven in, a short length of chain is unwound by the aid of the winch, in order that the fall of the monkey may always take place



according to the depth of the pile. The stop which limits the stroke of the piston also descends at will. The blow may be given in two ways: first, without releasing the monkey, which in that case rises and descends with the hook, striking very rapidly, but from a limited height; and secondly, from the full height. The monkey, then, on arriving at the end of its up-stroke, becomes detached, and after falling to effect the blow, is laid hold of by the hook and raised again for the next blow. Mr. Chrétien's apparatus has been used in the construction of some works which have just been completed in Paris, and, we hear, with perfect success.

Embriaco's Hydraulic Clock.*—Mr. R. P. Embriaco, of Rome, has invented a most ingenious system of clock, in which he substitutes water for the wheel-work

Fig. 1.

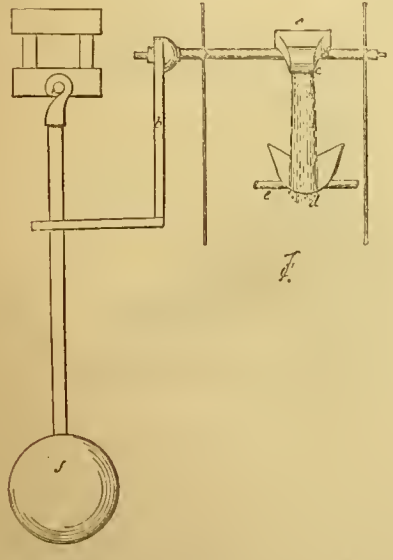
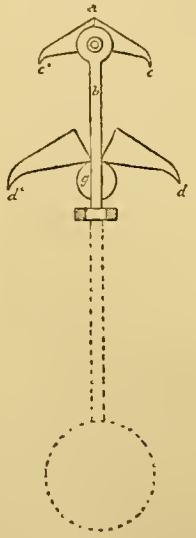


Fig. 2.



escapement, &c. in ordinary use. Figs. 1 and 2 represent sufficient portions of a clock to illustrate the principle of the invention. A spindle connected with the pendulum $f$ by a forked rod $b$, like the ordinary anchor rod, carries two slightly inclined planes $c$ $e'$, which are separated by a vertical partition $a$. The water falls from a reservoir, where it is maintained at a constant level, through a small orifice in a narrow stream, which, when the pendulum is at rest, descends upon the partition $a$, and is divided into two equal parts, which run off along the two inclined planes $c$ $e'$. When, on the contrary, the pendulum has received an initial impulsion, the stream falls alternately right and left of the central partition, and, by traversing the length of the inclined plane, maintains the pendulum in motion. Beneath the inclined planes there is disposed a small balance to receive the water, which escapes alternately at $e$ and $e'$. The water thus falling alternately into the receptacles $d$ and $d'$ of the balance, imparts a motion to them synchronous to that of the pendulum, which motion is transmitted to the hour and minute hands by a ratchet wheel, combined with the usual train of mechanism.

Doctor Sacc states that he has found in the tungstate of baryta a white, replacing with great advantages in paintings the white lead, which gets black by the hydrosulphuric emanations, and the white zinc, which had the disadvantage of not covering as much as an equal weight of white lead. The white from the tungstate of baryta is absolutely fixed, and covers perfectly.

* Translated from *La Propagation industrielle.*

## APPLICATIONS FOR
# PROVISIONAL PROTECTION FOR INVENTIONS
## UNDER THE PATENT LAW AMENDMENT ACT.

☞ When the city or town is not mentioned, London is to be understood.

*6th February* 1869.

367 C. S. Dawson, Thames Ditton—Paper-printing elastic stamp
368 H. A. Dufrène, Paris—Manufacturing ice.—A com.
369 J. S. Offord, Norwich—Clipping horses
370 W. R. Lake, Chancery Lane—Puddling furnaces.—A com.
371 R. Snook, Horsleydown—Cocks and valves
372 J. C. Shaw, Manchester—Cutting wire rods.—A com.
373 J. T. Edmonds, City Road—Medicine instrument for horses
374 H. A. Bonneville, Piccadilly—Preparing jelly broth.—A com.
375 C. D. J. Seitz, Bury—Furnaces
376 E. Meldrum, Dechmont—Paraffine oil
377 T. Harrison, Lincoln—Manure drills
378 B. Walker and W. Tilson, Nottingham—Reading machine

*8th February* 1869.

379 E. W. Hawes, Dublin—Constructing buoys
380 T. Nicholls and J. Parr, Lawton—Signal bells
381 L. Strauss and A. Seckbach, Watling Street—Preserving beer.—A com.
382 E. J. D. Fossard, Paris—Clyster-pump
383 R. W. Row, Alton—Glove fasteners
384 J. H. Johnson, Lincoln's Inn Fields—Steam-engine governors.—A com.
385 O. Sarony, Scarborough—Photographs
386 W. R. Lake, Chancery Lane—Puddling furnaces.—A com.
387 W. R. Lake, Chancery Lane—Knitting machines.—A com.
388 B. Hunt, Lincoln's Inn—Manometric-barometric apparatus.—A com.
389 H. J. Richman, Porchester Terrace—Fans.—A com.
390 F. Jenkin, Edinburgh—Electric light

*9th February* 1869.

391 W. A. Lyttle, Hammersmith—Electro-magnetic apparatus
392 R. Phelps, G. Phelps and C. W. Phelps, Birmingham—Infants' and invalids' feeding-bottles
393 G. Rees, Holloway—Producing designs upon glass and glazed ware
394 W. Williams, Nottingham—Communicating between passengers of railway trains
395 J. Dennell and G. W. Dennell, Leeds—Cutting the soles and heels for boots and shoes
396 J. Wilkinson and W. Scott, Bradford—Looms for weaving
397 G. White, Queen Street, Cheapside—Motive-power engine.—A com.
398 W. Mitchell, Stacksteads, Lancaster—Manufacture of felt carpeting
399 L. A. C. St.-Paul de Sinçay, Paris—Metallic tiles
400 G. Critchley and H. B. Fox, Liverpool—Rocking chairs and elastic seats
401 G. F. G. Desvignes Tulse Hill—Steam boilers
402 B. F. Sturvevant, Massachusetts—Blower for furnaces
403 J. H. Johnson, Lincoln's Inn Fields—Heating and ventilating
404 J. H. Johnson, Lincoln's Inn Fields—Manufacture of paper
405 E. J. A. Camère, Paris—Engines

*10th February* 1869.

406 K. B. Edwards, Claverton Street—Communicating between the guard, engine-driver, and passengers in railway trains
407 G. Gros, Paris—Self-shutting boxes
408 W. Hilton, Bolton—Looms for weaving
409 J. Crofts, Leeds—Operating on fibres in machinery for combing wool
410 J. Stuart, Limehouse—Separating animal from vegetable fibres
411 S. Mellor, Old Ford—Construction of pumps
412 W. Lever, Union Street, Southwark—Manufacture of hats
413 S. W. Mulloney, Coventry—Surgical bandage
414 C. T. E. Lascelles, Great Guilford Street, Southwark—Machine-made casks
415 F. J. Knewstub—Locks or fastenings for bags
416 J. F. Bentley, Peterborough—Filters
417 W. H. Fischer, Manchester—Photographing printing process
418 G. Broadhurst and J. Kershaw, Manchester—Manufacture of double texture cloths
419 P. Taysen, Leith—Manufacture of stearic and oleic acids
420 J. Clayton, Radcliffe—Paste for fixing and brightening aniline and pigment colours
421 J. Greenfield, Wandsworth—Hop-scotch cloths or boards
422 J. A. F. Suter and T. C. Hinde, Hereford—Production of heat for heating hollers
423 J. Carter, Birmingham—Water-closets
424 J. E. Billups, W. Cooper, G. T. A. Hine, and W. Young, Peckham—Communicating between passengers, guards, and drivers
425 W. R. Lake, Chancery Lane—Water velocipede.—A com.

*11th February* 1869.

426 G. F. Ansell, Russell Square—Manufacture of steel and iron
427 P. J. Smith, F. W. Smith, H. J. Smith, and A. Pappenberger, Bristol—Construction of pianofortes
428 G. A. Nowell, Nuneaton—Lamps
429 J. Young, Limefield—Measuring the pressure of gases and the force of aëriform or gaseous currents
430 H. P. Hansen, Leith—Stoves
431 C. Thomas, Bristol—Reaping machines.—A com.
432 B. P. Stockman, Abingdon Street—Water meters
433 A. C. Engert, Tabernacle Row—Manufacture of plain and ornamental mouldings

*12th February* 1869.

434 H. Edwards, Staple Inn—Preserved food
435 W. J. Horton, Warrington—Railway chairs
436 T. A. Collinson, Liverpool—Buttoned boots
437 F. J. Vandenvinne, Brussels—Plough for clearing or grubbing uncultivated land
438 W. H. Hayhurst, Blackburn—Looms for weaving
439 H. B. Binko, Islington—Manufacture and application of indigo, carmine, and other colours
440 T. V. Trew, Stratford—Screw propellers
441 G. H. Morgan, Edgware Road—Carriages
442 W. E. Newton, Chancery Lane—Manufacture of explosive compounds.—A com.
443 A. V. Newton, Chancery Lane—Rotary engine.—A com.
444 F. C. Hills, Deptford—Furnaces of gas retorts
445 W. Summers, Bristol—Packing cases for mineral waters and other bottles

*13th February* 1869.

446 C. Gordon, Goswell Road—Breech-loading firearms
447 A. W. Taylor, Holloway—Ceiling-walking
448 J. Holmes, Northampton—Sash-holder
449 W. E. Newton, Chancery Lane—Heating, generating steam, and cooking food.—A com.
450 D. Hanton, Lunan, N.B.—Ploughs
451 E. G. Brewer, Chancery Lane—Forming metallic joints or seams.—A com.
452 S. W. Campain, Lincoln—Drills for sowing seed and manure
453 W. Basford, Burslem, Stafford—Manufacture of bricks and tiles

*15th February* 1869.

454 W. Haycock and W. Carter, Manchester—Horse-shoes
455 B. Hunt, Lincoln's Inn—Saws.—A com.
456 A. Morton, Glasgow—Ejector condenser
457 W. H. Taylor, Chancery Lane—Harness buckle and loop
458 W. R. Lake, Chancery Lane—Changing shuttles and shuttle boxes in looms for weaving
459 E. J. Hill, Pimlico, and R. Davis, Strand—Signalling apparatus used in hand signal lamps
460 A. H. Lewis, Liverpool—Extracting copper from its ores.—A com.
461 T. Hattersley, Leeds—Spindles and flyers used in spinning
462 C. W. Lancaster, New Bond Street—Hollow wadding for breech-loading cartridges

*16th February* 1869.

463 S. Shaw, Boston, U.S.—Devices for lacing and buttoning boots and shoes.—A com.
464 T. Bond, Liverpool—Machinery employed in the construction of casks
465 T. Winder, Liverpool—Spring coupling
466 H. Posen, Finsbury—Fastening for purses, pocket-books, and belts.—A com.
467 T. Billyeald, Nottingham—Nets for ladies' hair
468 W. Smartt, Buckhurst hill—Application of heat
469 L. N. Legras, Wardour Street—Preservation and disinfection of animal and other substances
470 V. A. Houdaille, Paris—Metallic bungs for pressure vessels or vats
471 G. W. R. Pigott, Halifax—Manufacture of various articles of commerce
472 B. J. B. Mills, Southampton buildings—Brick-making machinery.—A com.
473 C. E. Brooman, Fleet Street—Treating waste wool, silk, horn, and other nitrogenized animal matters as manure.—A com.
474 H. Tylor, Cheapside—Spring bedsteads
475 A. McNeile and J. Slater, Pentonville—Carriage wheels
476 J. Fletcher, Bow—Feeding begass furnaces.—A com.
477 F. Walton, Staines—Artificial leather
478 H. Mulliner, Leamington, Warwick—Hanging broughams and other carriages
479 J. W. Yates, Birmingham—Spades, shovels, forks, and other similar articles

*17th February* 1869.

480 T. Sagar and T. Richmond, Burnley—Looms for weaving
481 J. Wood, B. Wood, and R. Wood, Sowerby bridge, York—Steam-engines
482 E. T. Hughes, Chancery Lane—Washing machines.—A com.
483 J. Atkins, Birmingham—Manufacture of metallic bedsteads and other articles
484 E. Round, Sheffield—Vessels for holding and cooling or warming fluids or solids
485 W. E. Newton, Chancery Lane—Adhesive stamps and railway passenger tickets.—A com.
486 F. H. Collins, Kensington Gardens—Construction of the permanent way of railways. A com.
487 A. Ransome, Chelsea—Wood-cutting machinery
488 W. R. Lake, Chancery Lane—Obtaining benzole.—A com.
489 H. D. Bowyer, Ripley, and J. L. Norton, Ludgate Hill—Manufacture of wheaten flour

*18th February* 1869.

490 H. Aland, Ronpell Street, Surrey—Compound rotary blowing fans
491 F. J. Knewstub, Saint James' Street—Fittings to be employed in despatch, writing, and other cases, boxes, drawers, or receptacles
492 J. Darlington, Moorgate Street—Mineral and rock-drilling apparatus
493 A Bartholomew, Glasgow—Apparatus for regulating the opening of sliding windows
494 A. Munro, Arbroath, and W. B. Adamson, Glasgow—Tools and machinery for cutting stone, slate, marble, rock, &c.
495 A. Garrison, Birmingham—Pendent string holder
496 J. D. Nichol and J. Eckersley, Edinburgh—Apparatus for drying and pressing printed paper
497 C. Brook, Halifax, L. Barker, Baildon, and M. Thompson, Halifax—Looms for weaving
498 R. Pyne, Wellington Street—Steps for the doors of railway and other carriages
499 J. A. Wade and John Cherry, Hornsea, York—Machine for pressing bricks, tiles, and other articles
500 T. H. Martin, Swansea—Tightening piston rings to the cylinders of steam or other engines
501 D. G. Fitzgerald, Battersea—Constructing electric telegraphs and voltaic batteries
502 J. Newton, Leeds—Machinery for spinning flax and other fibres
503 W. Daines, Gravesend—Improvements in anchors
504 F. W. Mallett, Connecticut, U.S.—Machine for making sewing needles
505 M. Vary, Scarborough—Ornamenting surfaces
506 F. Delbreil, Versailles, France—Apparatus for removing and facilitating the utilization of refuse matters
507 T. Forster and P. B. Cow, Streatham—Manufacture of india-rubber suction and other pipes

*19th February* 1869.

508 W. M. Cochrane, Surbiton—Vessels for containing water and other liquids
509 T. Tunstill and J. Dodgeon, Burnley—Looms for weaving
510 E. Dorsett, London Street—Apparatus for heating, smelting, and working metals, and in furnaces
511 A. Henry, Edinburgh—Breech-loading firearms
512 L. G. Moore, Erith—Feathering sails for windmills
513 J. Loader, Finsbury—Steam generators
514 S. Myers, New Bond Street—Churns and apparatus for whipping or beating eggs
515 T. Smith, Manchester—Treatment of flannel, carpets, druggets, and woollen cloths
516 J. Davey, Wisbeach—Motive-power engines
517 A. M. Clark, Chancery Lane—Increasing the tractive power of road and other locomotive engines and carriages.—A com.
518 E. Hewett, St. Leonard's—Cowls for chimneys and shafts
519 H. T. Jennings and T. Jennings, City Road—Steam-engines
520 J. Barton, Birkenhead—Water heater
521 W. R. Lake, Chancery Lane—Making and preserving ice.—A com.
522 M. MacLeman, Liverpool—Permanent way

*20th February* 1869.

523 G. G. Hairs, Little Distaff Lane—Burning and vaporizing combustible liquids
524 G. Green, Aberystwith—Buddles for separating ores and other materials
525 J. D. Gauldie and T. A. Marshall, Glasgow—Steam-engines and boilers
526 J. T. Wibberley, Leicester—Apparatus for winding cotton, silk, wool, or other threads on spools or reels
527 J. Mabson, Norwood—Drawing corks and receiving the wax and dirt which fall therefrom
528 A. Jacob, Bromley—Ventilation of sewers
529 J. Eberhard, Hampstead Road—Apparatus for propelling ships and other vessels
530 H. W. Whitehead, Holbeck—Machinery for combing wool, cotton, flax, and other fibrous substances
531 M. Gray, Highbury Hill—Manufacture of covered electrical conductors
532 J. H. Morl, Cambridge—Hair-cutting machines
533 T. H. Simmonds, Great Mitchell Street, St. Luke's, and E. B. Morcland, Bartholomew Close—Compound for glazing or "finishing" linen-faced paper used in the manufacture of collars and cuffs
534 B. P. West, New York, U.S.—Double-jointed butt hinge.—A com.
535 F. G. Fleury, Merrick Square—Meters for measuring water and other liquids
536 J. Daglish, Seaham Harbour, Durham—Ventilation of mines
537 R. Foster, Buxton—Construction of boilers
538 J. E. Lucas, Lombard Street—Floating velocipede.—A com.

*22nd February* 1869.

539 J. Weems and W. Weems, Johnstone—Machinery for malting, heating, drying, cooling, and ventilating
540 W. Ibetson, Strand, W. W. Ladelle, Wraysbury, Bucks, and A. G. Southby, Amesbury—Preparing esparto, straw, rags, or other materials for the manufacture of paper
541 S. Osborn, Sheffield—Knives and knife bars for reaping and mowing machines
542 J. O. C. Phillips, Birmingham—Construction of sets or partial sets of artificial teeth
543 J. W. Reid, Bayswater—Producing paper pulp or half stuff from wood and other fibrous materials
544 W. R. Lake, Chancery Lane—Heating apparatus for locomotive engines.—A com.
545 G. A. Fall, Hoboken, U.S.—Propelling vessels
546 T. S. Blair, Pennsylvania, U.S.—Manufacture of iron and steel
547 J. Leach, T. Leach, and J. Goodyear, Rochdale—Machinery for winding slivers or laps of wool, flax, cotton, &c.
548 B. J. B. Mills, Southampton Buildings—Manufacture of artificial stone.—A com.
549 J. E. Liller, Bedford—Apparatus for printing
550 J. H. Johnson, Lincoln's Inn Fields—Velocipedes.—A com.
551 W. E. Newton, Chancery Lane—Screw wrenches.—A com.
552 J. B. Rushbrook, Bury Saint Edmunds—Hurdle for folds for lambs and sheep
553 R. Meldrum, Pittormie, N.B.—Machinery or apparatus for stopping locomotive and other engines
554 J. Blyde, Sheffield—Scissors or apparatus suitable for gathering flowers
555 H. F. Frentel, Kingsland Road—Manufacture of hats and caps
556 R. P. Williams, Great George Street—Railway crossings and switches

*23rd February* 1869.

557 J. T. Gaze and J. Hymas, Erith—Grate bars
558 A. Jobson, Darlington—Machinery for discharging and in the arrangement and construction of coke ovens, also in utilizing the waste heat of coke ovens
559 J. Breeden, Birmingham—Taps or stop-cocks
560 J. Johnson and W. Gill, Unstone, Derby—Rotary engines and pumps
561 B. W. Farey, Bermondsey—Seatings or facings of gas valves
562 W. F. C. Moutrie, Southampton Row—Pianofortes
563 J. Neilson and J. Marshall, Glasgow—Applying trade marks, names, and devices upon metallic capsules
564 A. V. Newton, Chancery Lane—Fire boxes and ash pans of locomotive engines.—A com.
565 S. Holroyd, Manchester—Recovery of substances used in the purification of gas and of waste products
566 H. Bessemer, Cannon Street—Construction of machinery, apparatus, and buildings employed in the manufacture of cast steel

*24th February* 1869.

567 W. E. Gedge, Strand—Hand vice.—A com.
568 J. J. Myers, Spa Road, Southampton—Railway signalling apparatus
569 J. Whitehead, Oldham—Furnaces for steam boilers
570 W. A. Ives, Connecticut, U.S.—Mechanism for circular tenons and mortises
571 W. Williams, Liverpool—Laying and joining pipes for gas, water, and other like purposes
572 J. Cooke and G. Hibbert, Richmond, York—The use of one or more steam jets for obtaining vacuum power
573 B. Hunt, Lincoln's Inn—Regulating friction on the bobbins of machines used for spinning.—A com.
574 J. I. Vaughan, Kensal Green—Treating and utilizing the salts derived from the waste liquors of tinned plate works
575 R. Morton, Nine Elms—Manufacture of gas
576 G. Rees, Holloway—Producing designs and devices upon the surface of glass and glazed ware
577 J. T. Griffin, Fleet Street—Harvesting machines.—A com.

*25th February* 1869.

578 W. H. Tooth, Greenwich—Manufacture of bricks and tiles
579 E. A. V. Leroi, Paris—Cards of carding engines
580 W. Anyon, Manchester—Construction of velocipedes
581 H. Loewenberg, Berlin—Compound to be used in the manufacture of hats, bonnets, and other articles of wearing apparel
582 B. P. Walker, Wolverhampton—Shaping and finishing metallic and other articles
583 W. Turner, Hammersmith, Dublin, and J. W. Gibson, of Dundalk, Ireland—Friction rollers applicable to rolling bridges
584 J. Moody, Heworth Green, York—Apparatus for mooring vessels or floating bodies
585 W. Parkinson, Old Brompton—Wood-cutting machinery
586 W. E. Newton, Chancery Lane—Furnaces for oxidizing and desulphurizing iron and other ores.—A com.
587 E. D. Barker, Weston-super-Mare—Actuating railway breaks
588 L. Engel, Milk Street—Parasols and umbrellas
589 F. Brady, Regent's Park—Switch apparatus for railways
590 W. R. Harris, Paris—Manufacture of weavers' harness or healds, and in the machinery used for that purpose

*26th February* 1869.

591 W. T. Eley, Gray's Inn Road—Construction of cartridge cases for breech-loading firearms
592 H. J. Ledger, Manchester—Apparatus for enabling passengers to signal to the guard and driver of a train
593 H. Harburg, Hatton Garden—Musical boxes
594 T. Moore, South Stockton-on-Tees—Obtaining and applying power applicable to the raising and lowering of weights
595 W. R. Lake, Chancery Lane—Constructing ships and other vessels for carrying liquid cargoes.—A com.

596 J. Cheetham, Chadderton, Lancaster—Winding yarns
597 J. A. F. Suter and T. C. Hinde, Hereford—Furnaces for melting steel
598 G. J. Hinde, Wolverhampton—Coating iron or steel with copper or brass
599 J. T. H. Richardson, Tutbury, Stafford—Cutting flint glass
600 J. Townsend, Glasgow—Extracting and refining oils
601 E. Falck, Cheapside—Distributing liquids in a state of spray.—A com.
602 J. Reap and W. H. Michelmore, Borough Road—Spring hinges
603 C. Markham, Brimington, Derby—Steam and other boilers
604 W. A. Herring, Chertsey—Pumps
605 C. Williams, Plumstead—Obtaining motive power

*27th February* 1869.

606 J. Adams, Arlington Street, Sadler's Wells—Communicating and signalling between passengers, guards, and drivers of railway trains
607 W. Thomas and W. Davis, Aberdare—Winding machinery or apparatus employed in mines, shafts, pits, or lifts and inclined planes
608 J. R. Croskey, King William Street—Looms for weaving
609 R. Pyne, Wellington Street, Strand—Railway buffer carriage
610 J. H. Johnson, Lincoln's Inn Fields—Machinery for measuring raw silk.—A com.
611 C. Maw, Aldersgate Street—Cartridges and torpedoes
612 T. S. Blair, Pennsylvania, U.S.—Machinery for effecting the mixture of molten east iron with solid oxides
613 E. Chapman, Egremont, Cumberland—Carding engines
614 T. Atkinson, Bradford, York—Apparatus for lighting domestic and other fires
615 R. S. Norris, Liverpool—Getting coal
616 G. J. Snelus, Dowlais—Reducing iron ores
617 L. G. Lysons, Aberdeen—Apparatus for signalling from the marker's butt and firing party respectively, in rifle, carbine, or artillery practice

*1st March* 1869.

618 P. S. Regnauld, Paris—Fixing the lid and the bottom of tin canisters
619 J. Ladley, Leeds—Spinning and twisting wool
620 R. J. Goodbody and E. Donovan, Dublin—Treating tobacco
621 J. Rust, Lambeth—Composition for pictorial and decorative purposes
622 W. E. Gedge, Strand—Breech-loading firearms and cartridges.—A com.
623 W. Simpson and A. Gardner, Ilford—Steam-engines
624 A. H. Brandon, Paris—Metallic cartridges.—A com.
625 W. R. Lake, Chancery Lane—Lawn-mowing machine.—A com.
626 D. Davies, Newport—Getting coal, stone, slate, or mineral
627 J. Cliff, Runcorn—Use and application of certain materials as a substitute for fire-bricks
628 J. Hadley, Upper Thames Street—Decorticating apparatus
629 A. H. Honegger, Manchester—Portable copying press
630 B. C. Crawford, Newcastle-upon-Tyne—Steam boilers or generators
631 C. E. Brooman, Fleet Street—Spring mattresses and bedsteads.—A com.
632 J. G. Willans, Paddington—Manufacture of iron and steel

*2nd March* 1869.

633 W. Olley, Enfield—Circular saw benches
634 J. Farrington, Clarendon Square, St. Pancras—Apparatus for travelling with ease, speed, and safety
635 F. N. Gisborne, West Strand, and H. Allman, Ampthill Square—Metal tubes
636 J. Hall, Hounslow Heath—Horseshoes
637 J. Townsend and P. Forbes, Glasgow—Purifying oils and fats
638 J. Woods, J. Hampson, L. Fish, and G. Fish, Preston—Working temples and rollers for power-looms
639 J. Howe, Boston, U.S.—Navigable vessels

*3rd March* 1869.

640 W. Clark, Baker Street, Portman Square—Clipping or shearing horses
641 F. A. Gatty, Accrington, Lancaster—Obtaining the colouring matter of madder
642 J. Cooke and G. Hibbert, Richmond, York—Circulating heat motive-power engine
643 J. Sloper, Walbrook—Perforating or stamping cardboard and metal
644 H. W. Goldring, Moorgate Street—Cleaning cotton seed
645 R. Law and S. Hargreaves, Burnley, Lancaster—Warping
646 F. Andoe, Swansea—Fire-escape
647 J. Robertson and J. Shanks, Barrhead, N.B.—Blowing apparatus for smiths' forges
648 E. Lyons, Birmingham—Lamps for volatile oils or spirits
649 W. Howes and W. Burley, Birmingham—Carriage lamps
650 H. A. Bonneville, Paris—Apparatus for doubling stuffs and tissues.—A com.
651 W. E. Newton, Chancery Lane—Water-closets.—A com.
652 R. Wright, Richmond, York—Doors for railway carriages and communicating between the passengers and guard

*4th March* 1869.

653 D. Sword, Edinburgh, N.B.—Supplying water to cattle-trucks or waggons
654 A. A. L. P. Cochrane, Westminster—Marine structures
655 W. H. Tooth and W. H. Tooth (jun.), Greenwich—Furnaces
656 E. T. Hughes, Chancery Lane—Casting chain.—A com.
657 M. G. Cole, Bexley Heath, Kent—Watches and other timepieces
658 T. Howcroft and A. McGregor, Bedford Leigh, Lancaster—Reaping and mowing
659 S. Marsden, Manchester—Bolts and rivets
660 T. Greenwood, Leeds—Screw-gill roving-frames
661 J. B. Spence, Manchester—Purification of gas and recovery of a waste product
662 T. Forster, Streatham, and R. Taylor, Kennington—Printing rollers
663 W. Macrae, Johnstone, N.B.—Velocipedes
664 J. H. Johnson, Lincoln's Inn Fields—Dyeing and printing with aniline colours.—A com.
665 W. Betts, Wharf Road, City Road—Producing trade-marks on capsules
666 J. Gough, Hatton Garden—Cylinders for containing and distributing colour

*5th March* 1869.

667 C. Tighe, Poultry—Studs or buttons and mode of securing them
668 C. D. Abel, Chancery Lane—Injector.—A com.
669 F. Windhausen, Brunswick, Germany—Ice-making machines
670 W. E. Gedge, Strand—Preserving from oxidation ships and metallic surfaces.—A com.
671 H. Knight, Ryde, Isle of Wight—Apparatus for clipping horses and other animals
672 H. A. Bonneville, Paris—Fastening the knots of neckties.—A com.
673 C. E. Brooman, Fleet Street—Manufacture of fabrics by the employment of fur or down.—A com.
674 W. B. Waterlow, London Wall—Stamping or dating press

*6th March* 1869.

675 J. Holding, Manchester—Looms for weaving
676 J. Loader, Upper Clifton Street, Worship Square—Rotary engines and pumps
677 R. Badger, Sawbridgeworth—Shears and scissors
678 W. S. Meldrum, Leeds—Carding engines
679 J. B. Spence, Manchester—Substances used in the purification of gas and recovery of a waste product
680 A. Morrall, Studley, Warwick—Needle-threader
681 T. Ross, Glasgow—Slides for magic lanterns
682 H. Ellis and J. Ellis, Salford, Lancaster—Cranes
683 W. G. Simon, Oakley Square—Hank for hoisting and lowering fore and aft sails
684 R. R. Bevis, Birkenhead—Screw propellers
685 A. M. Clark, Chancery Lane—Envelopes.—A com.

*8th March* 1869.

686 A. Dixon, Railway Place, Fenchurch Street—Steam lubricators
687 J. A. McElroy, Glasgow—Pumps
688 J. B. Rowcliffe, Manchester—Wire cloth for paper-making machines
689 W. Burr, King Edward Street—Manufacture of compressed leather
690 W. A. Gilbee, South Street, Finsbury—Raising water.—A com.
691 J. Pitt, J. Pitt, E. Pitt, and W. Pitt, Cleckheaton, York—Drilling, turning, cutting, and shaping metals
692 C. Mather and W. Rossetter, Salford—Warping and weaving machinery
693 C. Fairbairn, Sciennes, Edinburgh—Furnaces
694 L. M. Ruiz, Paris—Purifying oils.—A com.
695 H. Tylor, Cheapside—Spring bottoms for bedsteads, couches, and seats
696 P. Buchan and A. Guild, Belfast—Preparing jute and other vegetable fibres
697 J. A. Jaques, Tottenham, J. T. Oakley, Bermondsey, and J. A. Fanshawe, Tottenham—Grinding and surfacing rings, plates, and discs of iron or steel
698 H. W. Cook, Ovington Square—Regulating clocks
699 J. P. Budd, Swansea—Manufacture of iron and steel
700 R. F. Piltz and T. H. Lee, Newnham Street, Edgware Road—Paper hangings
701 R. Turnbull and J. G. Piton, Cornhill—Apparatus for signalling
702 T. Baker, Stratford—Umbrellas and parasols
703 W. B. Thompson, Dundee, N.B.—Finishing textile fabrics
704 A. Mitchell, Leith, N.B.—Cutting or dressing stone
705 W. Saunders and C. Smith, Newgate Street—Board frame for dressing hags
706 W. Saunders and C. Smith, Newgate Street—Combined chess and cribbage-board or table

*9th March* 1869.

707 W. R. Lake, Chancery Lane—Converting reciprocating motion into rotary motion.—A com.
708 F. F. Villepigue, Northumberland Street—Velocipedes
709 W. R. Lake, Chancery Lane—Tilt-hammers and applying power.—A com.
710 R. Briggs, Leeds, York—Regulating temperature
711 J. J. Shedlock, King's Road, Camden Town—Wet gas-meters
712 J. J. Shedlock, King's Road, Camden Town—Dry gas-meters
713 H. A. Bonneville, Paris—Manufacturing of porcelain.—A com.
714 H. Mason, G. Hartley, and J. Hindle, Bradford—Looms
715 I. Hudson, Stockport—"Tilts" for casks
716 J. Dickie, Glasgow, N.B.—Grates
717 B. Hunt, Serle Street—Road locomotives.—A com.
718 W. R. Lake, Chancery Lane—Turbine wheels.—A com.
719 A. M. Clark, Chancery Lane—Umbrella and parasol coverings.—A com.
720 H. W. Goldring, Moorgate Street—Manufacture of soap
721 G. Goldsmith, Leicester—Railway signalling
722 G. H. T. Finzel, Bristol—Cooling and sifting animal charcoal
723 R. M. Caffall and D. Miller, Alton, Southampton—Rendering walls and other surfaces impervious to the action of water
724 J. Henderson, Castle-Douglas, N.B.—Manufacture of iron and steel
725 J. Edwards, Hackney—Railways and signalling
726 W. Saunders and C. Smith, Newgate Street—Dressing-case and bag
727 G. Spencer, Cannon Street, London, and J. Barker, Mortlake, Surrey—Preserving animal and vegetable matters
728 T. Obach, Manchester—Fuel economisers and fixing pipes
729 W. Walker, Newton Heath, Manchester—Slide-valve gear

*10th March* 1869.

730 W. R. Lake, Chancery Lane—Self-lighting gas-burners.—A com.
731 B. Britten, Red Hill, Surrey—Whips
732 W. Weldon, Highgate—Obtaining compounds of manganese from chlorine residues
733 J. Sax, Bloomsbury—Receiving instruments of telegraphs
734 W. Bowles, Bolton, Lancaster—Mules for spinning
735 R. Rule, Glasgow, N.B.—Weaving ornamental fabrics
736 C. Drake, W. Drake, and J. Drake, New Kent Road—Breaking stone for and mixing concrete
737 F. O. Palmer, Hurstpierpoint—Conveying goods or passengers
738 G. Spencer, 77 Cannon Street—Preserving corn and other substances
739 A. Moncrieff, Culfargie, Perth, N.B.—Working ordnance on the "Moncrieff" system
740 D. Johnson, Wrexham, Denbigh—Cleaning grain

*11th March* 1869.

741 J. B. Bernier, Wilmington Square—Preservation of yeast
742 T. H. Harrison, Liverpool—Water closets
743 W. Wells, Manchester—Apparatus for sanitary purposes
744 G. Clover, Ranelagh Road, Pimlico—Imparting colours to hydro-carbonaceous fluids.—A com.
745 W. H. Clapp, Ball's Pond—Signal lanterns
746 J. Waddington, A. Waddington, and F. Bell, Barrow-in-Furness, Lancashire—Condensing and utilizing steam
747 W. Betts, City Road—Manufacture of capsules
748 C. H. Cooper, Birmingham—Whip-sockets
749 J. Bathgate, Edinburgh, N.B.—Gas-meters
750 W. E. Newton, Chancery Lane—Cases for cigars.—A com.
751 W. E. Newton, Chancery Lane—Adjusting cords for hanging pictures.—A com.
752 T. Greenwood, Leeds—Preparing silk waste
753 J. H. Johnson, Lincoln's Inn Fields—Artificial fuel, gas, and coke.—A com.
754 Henry Ormson, Chelsea—Hot-water apparatus
755 J. M. Napier, Lambeth—Manufacture of moneys, coins, and medals
756 George Smith, Headingley, York—Finishing cloths and mixed fabrics
757 F. R. Aikman, Brompton—Fircarms and ordnance
758 T. Beeley, Chester, and David Hanson, Dukinfield, Chester—Welding plates and tubes for boilers
759 W. R. Lake—Chancery Lane—Spinning and fibrous materials.—A com.

*12th March* 1869.

760 W. Coxhead, Gresham Street—Goloshes.—A com.
761 E. F. R. Lucas, Middlesborough-on-Tees, York—Soluble phosphate of lime and phosphatic manures
762 H. J. B. Kendall, Great Winchester Street—Preservative paint.—A com.
763 J. Porteous, Edinburgh, and H. Gibson, Musselburgh—Manufacture of tobacco
764 D. S. Price, Great George Street, Westminster—Paving for roads and tramways
765 E. Pritchard, Fenchurch Street—Safety button or stud
766 G. Bray, Deptford—Connecting and disconnecting apparatus for carriages
767 J. Cooke, Lincoln—Ploughs
768 H. J. Cénant, Tubize, Belgium—Steam and water
769 C. E. Brooman, Fleet Street—Manufacture of salt.—A com.
770 L. Labadie, Bordeaux, France—Magnetic regulator applicable to compasses
771 J. Duffey, Chelsea—Railway brake and coupling apparatus
772 A. M. Clark, Chancery Lane—Preparation of pulp for paper.—A com.

# IMPROVED ENGINE COUNTER.

CAPTAIN LORD JOHN HAY, R. N.
Patentee.



Fig. 1.

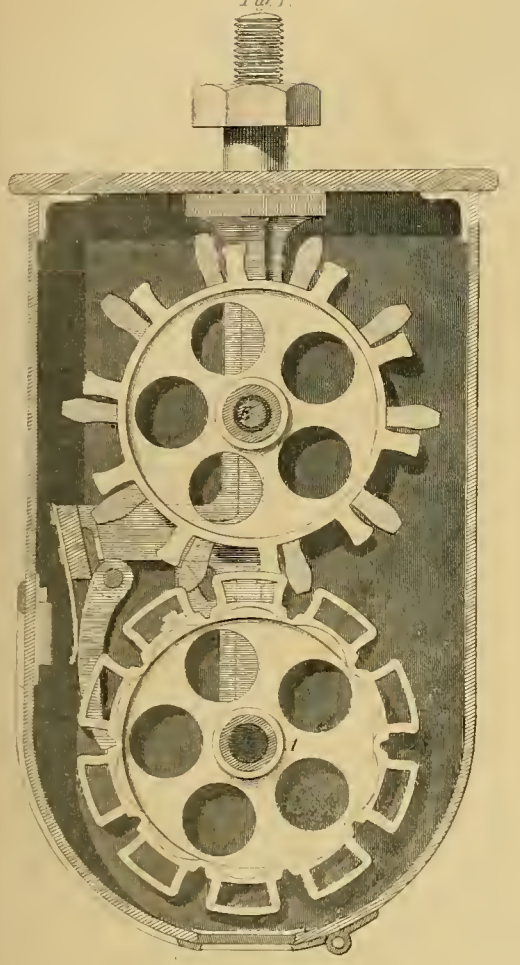


Fig. 2.

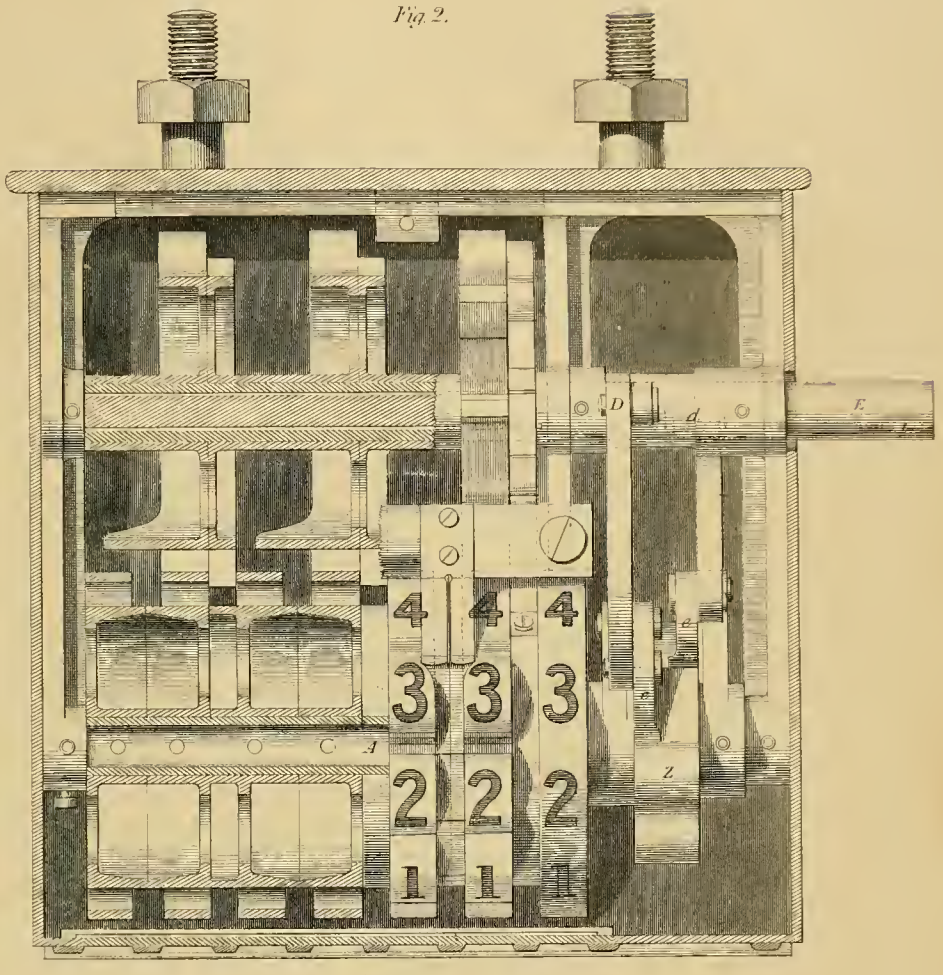



Fig. 3.

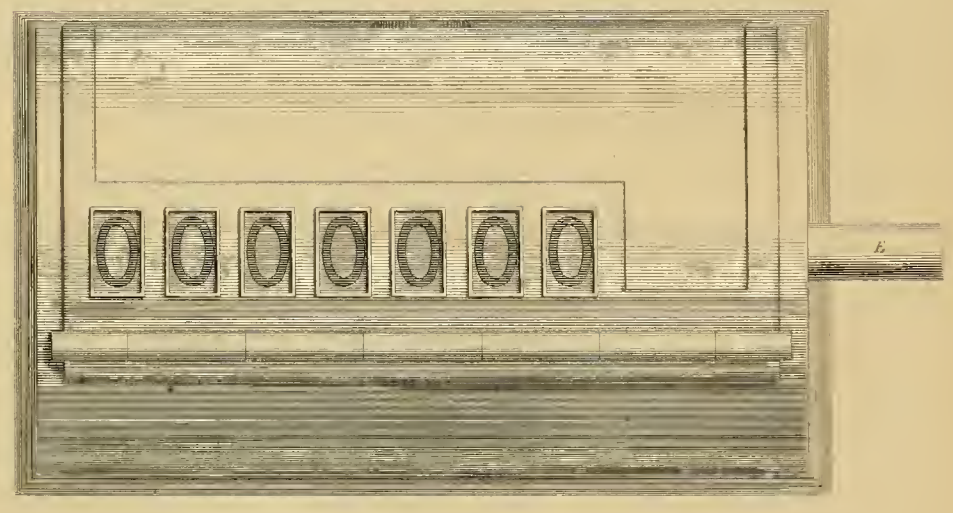



Fig. 4.

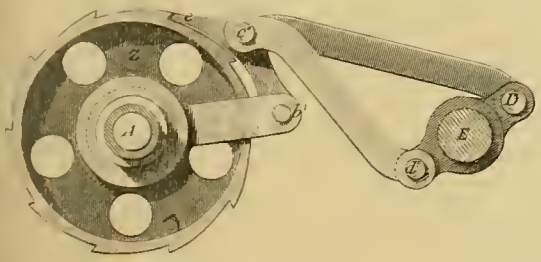



Fig. 5.

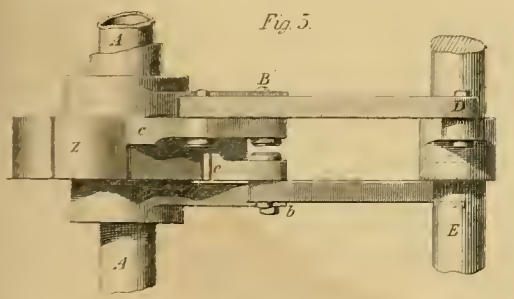



Fig. 6.

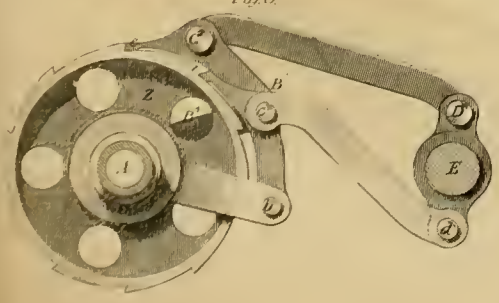
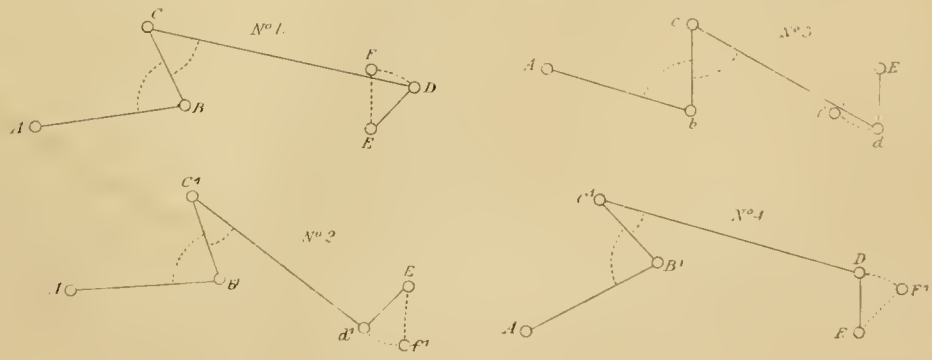



Fig. 7.



# ROTATORY COAL CUTTING MACHINE.

BY MESSRS. JOHN GILLOTT & PETER COPLEY.
Patentees.

Fig. 1.

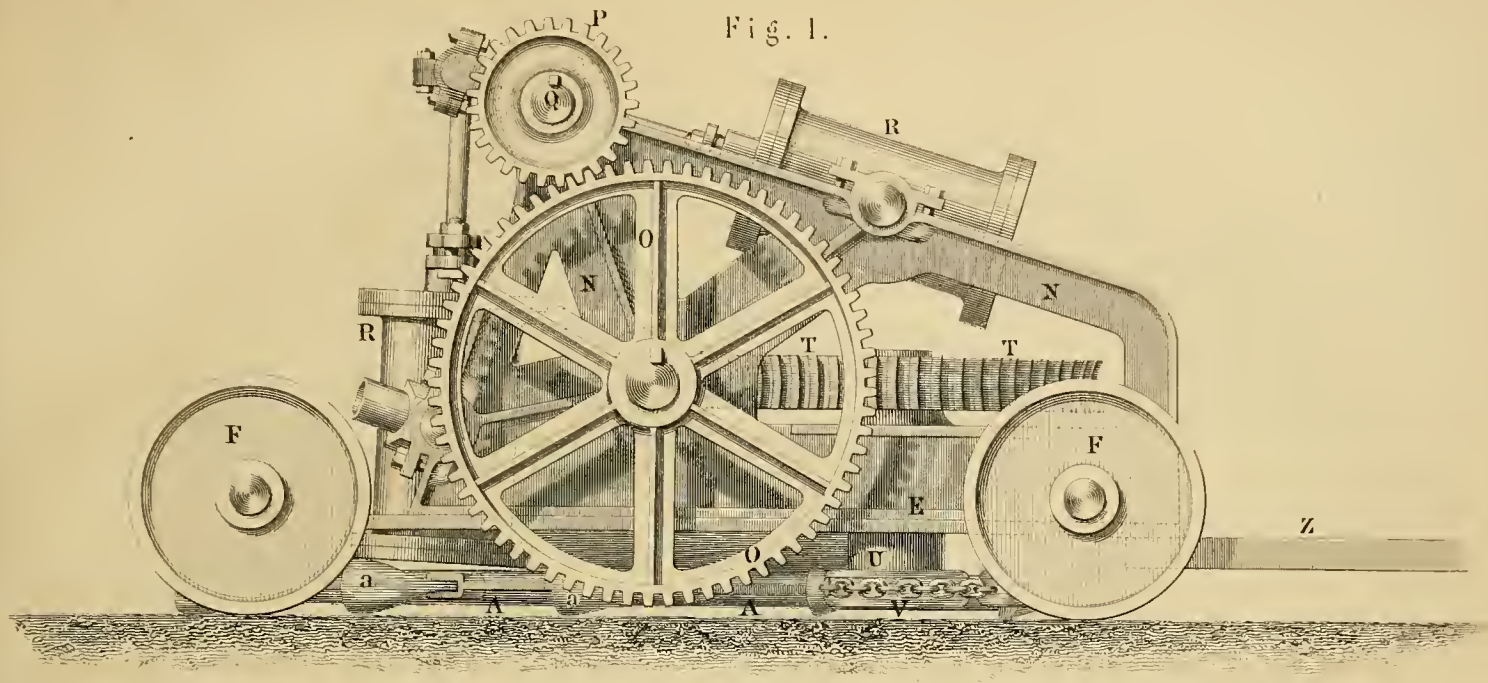
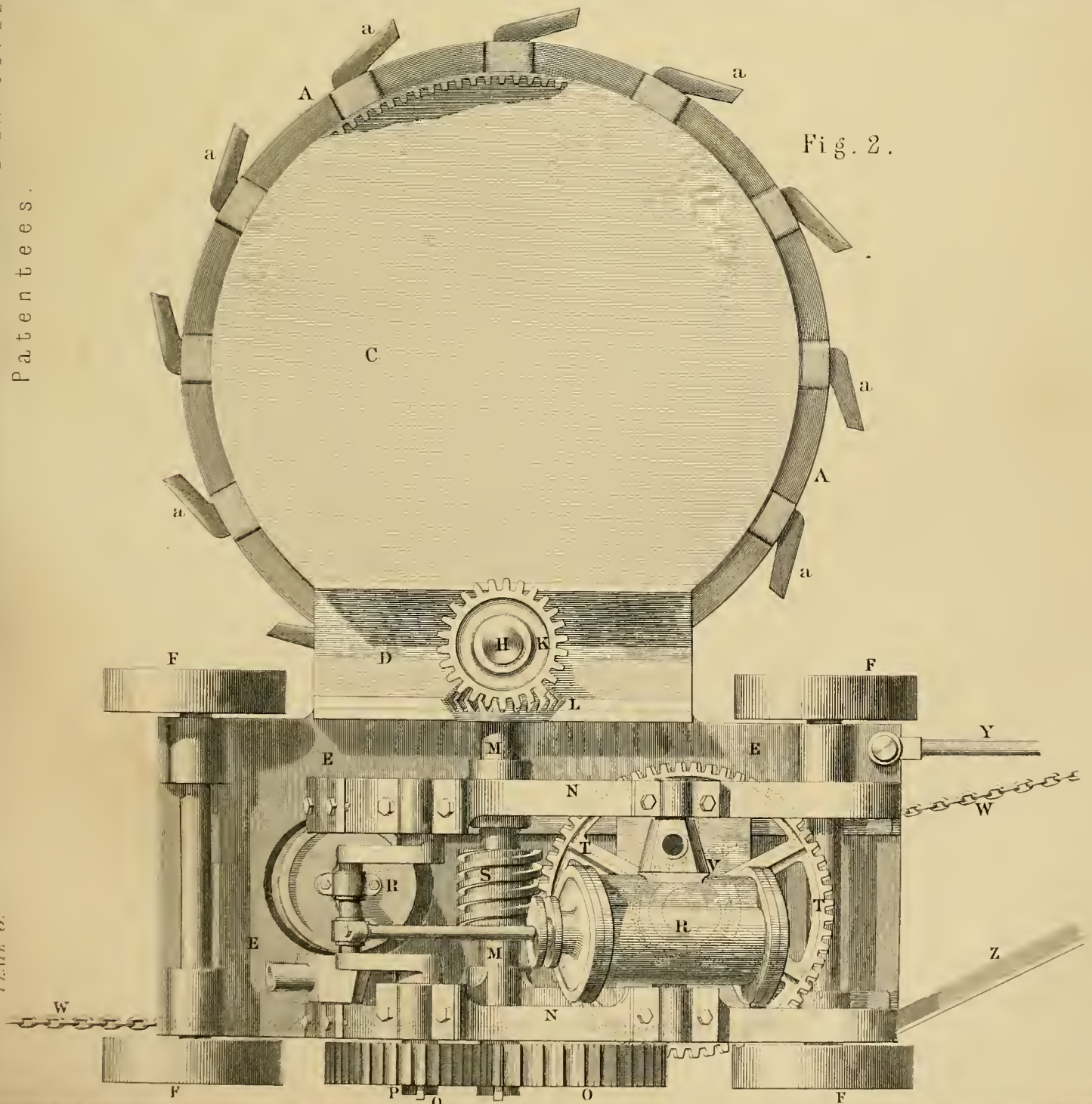



Fig. 2.




Practical Mechanics Journal
Vol. VIII.
Plate 3.

Office, 47 Lincoln Inn Fields London, and 166 Buchanan St. Glasgow.

# SCREW CUTTING MACHINERY.

M. DE RÉSENER _ PARIS.
Patentee



Fig. 3.

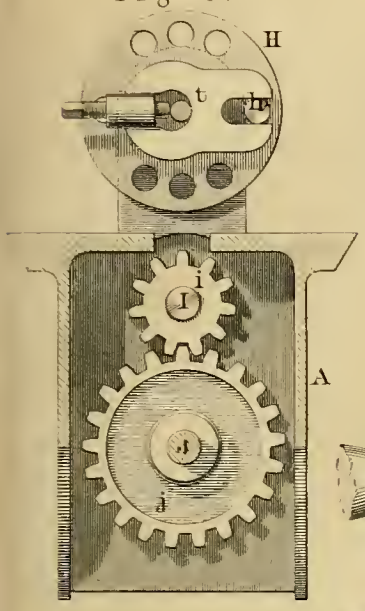



Fig. 1.

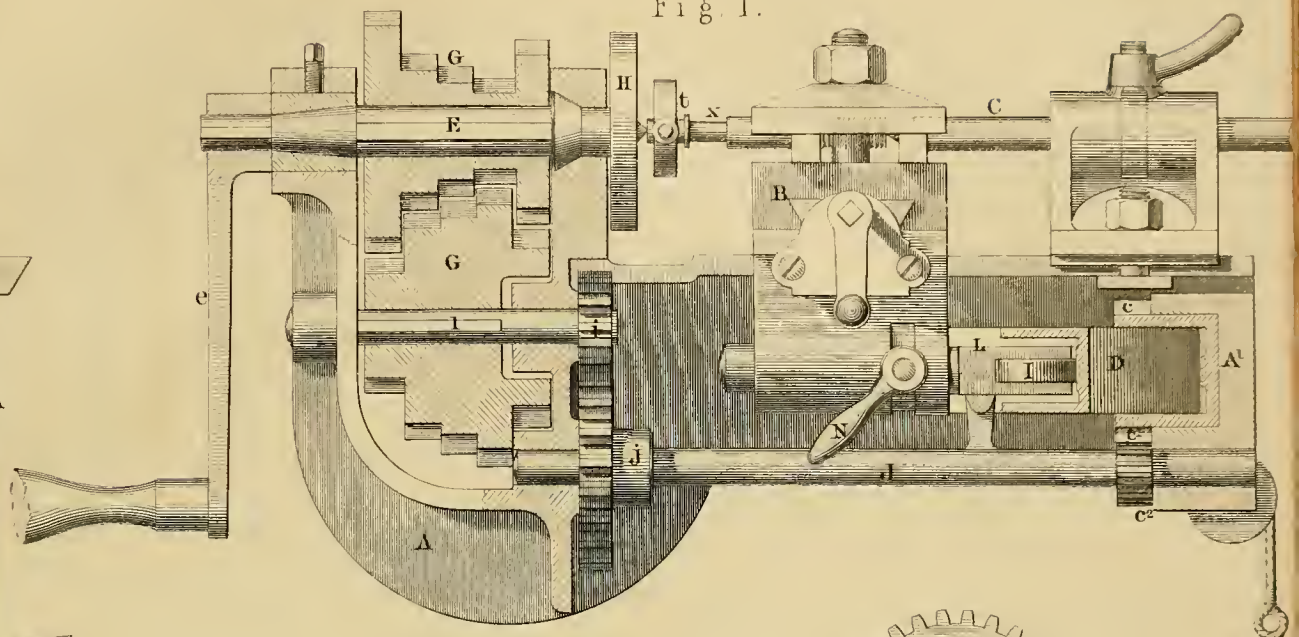



Fig. 5.

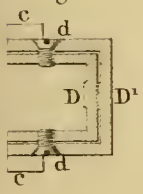
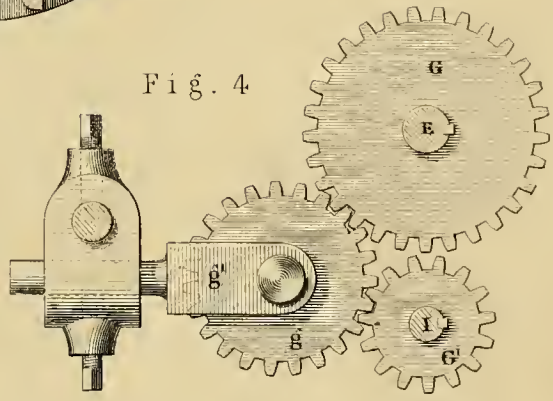



Fig. 4



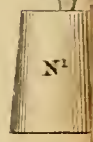




Fig. 6.




Fig. 2.

## ON SOME POINTS OF PRACTICE IN IRON FOUNDING. NO. XXXV.

*"Casting in or on" to the same or to other metals.*

When we say other metals, we practically mean cast iron, wrought iron, or steel, for no other metals occurring on the large scale in the arts have fusing temperatures such as admit of the processes about to be referred to being applied to them.

Occasionally, though rarely, a few substances, not metallic, may be perhaps usefully treated, by the methods of "casting in or on"—for example, grit-stone or blocks of emery might be run round with cast iron so as to unite these into large grinding plates or cylindric surfaces and the like; but these are out of our way just now.

Whenever liquid cast iron, of whatever kind, is brought into contact with a comparatively cold surface of good conducting material, it is, as we have already seen, more or less "chilled;" its texture is altered, its hardness increased with its absolute cohesion, but its toughness diminished.

This occurs more or less whenever a piece of wrought iron, or of steel, or of cast iron, cold or but moderately heated, is laid into a sand or loam mould, and the liquid iron which fills the mould comes into contact with it.

Conversely the wrought iron or the steel (and even less completely, and with somewhat different conditions), the cast iron with which the liquid cast iron has been brought into contact, and with which it has to cool slowly and at the same rate, have their molecular status changed also.

The wrought iron loses in ultimate cohesion and likewise in toughness, and new crystalline arrangements are formed within its mass, which, on the whole, deteriorate it as a structural material.

Changes of like character are produced in steel, but not to the same extent, and tend rather to the enlargement of its constituent crystals than to materially injure it as a structural substance.

Theory alone would thus appear to place its ban upon any such operation as "casting in or on," and in some cases the verdict of mere theory would be approved as true, in its application to practice.

Yet there are very many cases occurring in the every-day work of the iron-founder and mechanical engineer, in which the convenience and the economy of this method of uniting the metals are so great, and the changes induced upon both so unimportant, that theory is wisely overlooked or overridden in practice. Before alluding to some of these, let us take a glance at some of the cases in which theory *ought* to be our guide here, and in which the neglect of it is nearly certain to bring the practician to grief.

This will be the case whenever it is important that the full and undiminished strength and toughness of both metals, the wrought iron and the cast iron, should be preserved.

The "crucial instance" of a case in which this is indispensable may be said to be found in the construction of artillery, machines in which every particle of the constituent material is simultaneously strained in three directions at right angles to each other, and by force suddenly or impulsively applied, and always so great as to bear a large ratio to the ultimate or crippling strain of the metal.

Here, then, of all others, is the case in which "casting in" should have been avoided. Yet the method of making cannon by casting bronze or cast iron round a wrought iron or steel interior tube has been again and again proposed and often tried. In the older days of iron metallurgy, when these subjects were less distinctly understood, and when want of good tools gave some strong inducements, on economic grounds this method was excusable. The very same proposition has been but recently revived, however, by Major Palliser; and it was not before a large gun was blown to pieces at, we believe, the first round, at Woolwich, that the inventor, with infinite candour, publicly declared that thenceforth he abandoned his method (which was not his, in fact), and conceded his adhesion when too late to the indications of theory. We are not always called upon to provide for such strains as cannon are exposed to, but whenever the strains upon any machine or structure are severe, and especially when they are impulsive, we shall do well to avoid "casting in."

Yet cases continually occur in practice where, even upon a very large scale, this method of combining the metals by laying the wrought iron into the mould and casting the cast iron round it, may be practised with advantage and safety.

Thus, for example, in some of the great iron latticed viaducts upon the Commentry and Gannat branch line of the great Orleans system of railways in France, Mr. Nordling, C.E., the engineer-in-chief, has adopted the suggestion made to him by M. Eiffel, the founder and contractor for the iron-work of La Sioule Viaduct, and has united the corner or gusset plates of wrought iron with the cylindrical columns or shafts of the iron piers (which are of vast altitude), by casting the former into the cast iron of the columns. The success of the process appears to be complete in this instance. Here the mass of cast iron in immediate contact with the wrought iron is relatively large. There is, therefore, no very serious deterioration produced in the cast iron, which is the metal the more obnoxious to injury of the two; and on the other hand, the margin of safety allowed in all parts of these structures, and more particularly in the mass of these gusset plates, admits of some deterioration in the wrought iron constituting them, without running any risk.

To pass to the other extreme in point of dimension, we see this method in continual use amongst the founders of ornamental castings, such as light balusters, balcony panels, &c., into the sand moulds for which are laid short pieces of iron rod or wire, which, when "cast into" the extremities of these castings, become the means by which they are united by screw nutting or by riveting with the hand-rails and other parts of the architectural structures into which they enter. Here, as both cast and wrought iron are small in scantling, and the subsequent strains are small, some loss of strength or of toughness can be afforded in consideration of economy.

Our chief aim now is to point out how largely and advantageously this method may have its use extended, and to give some examples. Let us first, however, recur in some degree to theory, and in the way of correcting a very prevalent error amongst many who might be presumed to know better, as to what *can* be effected by this method of casting in. It has been supposed over and over again that additional strength and toughness may be conferred upon castings in iron by including in their interior a wrought-iron skeleton, which the cast iron when run around it, shall clothe with itself, as the flesh encloses the bones of an animal. Thus, to quote but one example, several years ago, in the early days of railways, the late Mr. George Forrester, of Vauxhall Foundry, Liverpool, patented a method for making improved cast-iron wheels for railway wagons, by riveting or welding together in a rough and cheap way a sort of skeleton wrought-iron wheel. This was tinned or galvanised, and after having been warmed, was laid in the dry sand mould, and the cast-iron wheel was poured and formed around it.

Such wheels proved admittedly to be no better than if simply of cast iron, probably were not nearly as good as a well-made American chilled rim cast-iron wheel, and probably were in reality rather worse than the same cast wheels would have been *minus* their wrought-iron bones. It may be accepted as a fact, that no real accession of strength can be thus attained in any casting, if the cast iron be good soft grey or mottled metal; inasmuch as the extension per ton per inch of such, is actually greater than that of wrought iron for the first ton or two, so up to that limit at least the whole strain will come upon the one material only, helped by the slight surface adhesion of the two. Both materials also are in a state of initial strain more or less, dependent upon their diverse coefficients of contraction and their differences of temperature at the instant of consolidation of the cast iron. If, again, the cast iron be rigid and harsh, white or chilled or light mottled iron, then the whole strain again is on one of the two; and so these wheels, if made hard enough to have a tolerably well-wearing rim or tread, might break all to pieces, and all that the wrought-iron skeleton inside could do would be more or less imperfectly to hold the fragments loosely together. A remarkable and not uninstructive example of this was seen in 1867 at Paris, at the Great Exhibition contest between the bank safes of Mr. Herring and Mr. Chatwood. The former maker fills the space between the outer and inner wrought-iron or steel plates

of his safes with a plate of intensely hard Franklinite iron, poured in while in fusion, *i.e.* iron made from the mineral so called, consisting of oxide of iron and oxide of zinc, found in the State of New Jersey. This is so hard that it cannot be drilled by ordinary means, but it is also extremely brittle, more so, apparently, than any ordinary white or chilled iron; as an alleged remedy for this, the Franklinite was cast upon or around a sort of network of tough wrought-iron cylindrical rods of about $\frac{5}{16}$-inch diameter, and it was affirmed that these conferred upon their hard and brittle surroundings their own toughness. When, however, plates of this combined material were broken up, which a few blows from a heavy hand-hammer were enough to effect, they proved just as brittle as ever. The dislocated fragments, it is true, or some of them, hung together, though more or less separated, by means of the reticulation of tough wrought-iron wires, and whose toughness did not in this instance seem to have suffered much change; but the plate as a whole broke up readily as before, and admitted of fragments being beaten out of it.

In Mr. Kirkaldy's museum at his testing works, Southwark, is a heavy cylinder of cast iron of very fine quality, in the middle of which is seen a very heavy concentric cylindrical bar of rather rigid wrought iron, cast into it.

The original proprietor of this notable compound bar, of whom we know nothing, it appears brought it to be tested, and requested that the proof should be only carried up to some few tons per square inch, the allegation being that the cylinder was of some secret and improved *cast iron*. Arrived at this limit, the extensions appeared so strange to the experienced eye of Mr. Kirkaldy that he resolved to go on *à l'outrance*, and so broke or pulled the cylinder in two, when, to the disgrace of some "person or persons unknown," the big wrought-iron bar was discovered in the middle. It was *this* bar, in fact, that was bearing nearly all the strain for the first few tons, and the cast iron when broken showed itself no better than common.

It was creditable to the experimenter to have thus detected a disgraceful attempt at a *quasi* scientific fraud, but, besides the moral, we may draw also the physical lesson which we have been otherwise inculcating, from the result.

We thus may take it for granted that no increase of resistance, of any industrial value at least, can be secured by trying to combine cast iron and wrought iron or steel, by casting in, or one within the other.

The advantages of casting in are limited, in reality, to economy, rapidity of execution, and convenience. We shall see that incidentally, however, in the case of wrought-iron structures such as iron railings, or, as our French readers will better understand, *grilles*, certain additional advantages are secured.

The two following examples will at once illustrate the methods of practically employing the "casting in or on" process, and point out two of the chief classes of manufactured objects to which the process may with most advantage be applied.

We shall take, first, the patent secured some years ago by Mr. David Moline for a method of producing window sashes or frames by combining wrought iron with cast iron. The "muntins" of these sashes are formed of rolled wrought-iron bars in any of the usual rabbated sections fitted to receive the glass. These are cut or shorn off into appropriate straight lengths, equal nearly to the straight (or curved) sides of the panes. An iron pattern moulds the entire sash in the sand; when it is withdrawn, these straight pieces of iron sash-bar are laid into their respective places in the sand mould so that their ends approximate, four such coming together at each intersecting point, if the sash have square or rectangular panes. A boss or *patera* is moulded at each such intersection, as shown in fig. 1, ornamented or not, but of sufficient size to embrace the four disconnected ends of the wrought-iron bars, and when cast in iron, to solder or unite these together into one. These bosses are then "poured," either simultaneously by the aid of a compound "runner," or one or more at a time; the sash is then complete, all the loose pieces of "muntin" being so united together. Sashes thus made present the appearance shown in the figs. 2, 3, and 4:—

FIG. 1.

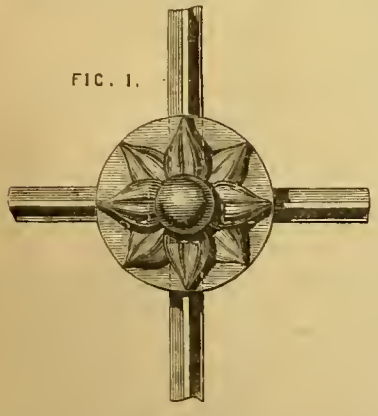
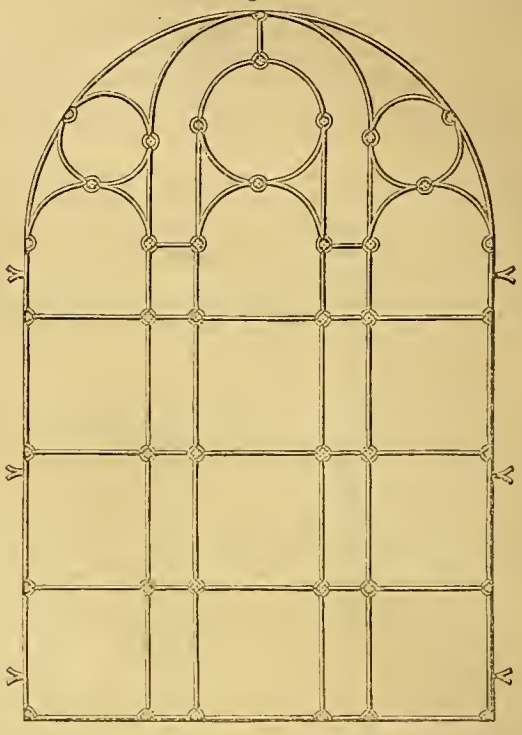
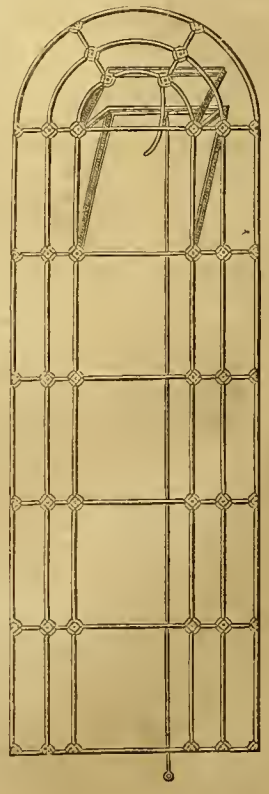


Fig. 2.



They are extremely strong, may be made very ornamental, and have immense advantages, both in manufacture and in use, over the older sashes wholly of cast iron, in casting which it was always extremely difficult to preserve a light and large "muntined" sash free from bending, distortion, or fracture of some of the "muntins" while cooling, and the whole affair, if large, was so fragile as to scarcely bear transport, and to offer no resistance to violence.

Fig. 3.



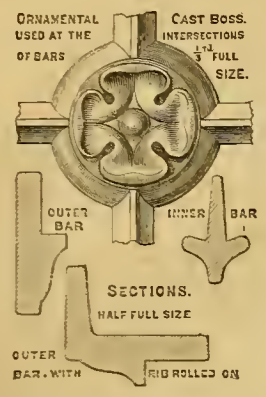
The older and wholly wrought-iron sashes, on the other hand, in which the "muntins" intersected, and were united by "halving" or riveting to each other, were neither neat nor cheap.

Excellent examples of these improved sashes may be seen in the windows of the Ludgate Hill Station buildings of the London, Chatham, and Dover Railway Station, in the front of the new Covent Garden Theatre, and in many other places in London.

Casting wrought-iron pieces together in this sort of way is plainly not confined to the production of sashes. In fact, it has been employed, and with excellent effect, by Mr. Thomas Page, C.E., in the production of two or three different classes of wrought-iron trellis railing, or fence, at the Chelsea Suspension Bridge, London, and its use in this direction might be largely extended with advantage.

The other example to which we shall refer is that of the grand line of *grille* or railing which extends for about 1,600 feet in a straight line, and forms the northern side of Nassau Street, in Dublin, separating that from the park of Trinity College. This was designed by and executed under the direction of the writer. It consists of a succession of cast-iron perforated pilasters, of ornamental open work and work in relief, with caps and bases, and sustained by two scroll struts at the rear, at intervals of about 50 feet. These are "cramped," *i.e.* run with an alloy of lead and zinc, into the granite continuous base. The spaces between these are filled up by the *grille*, consisting of a flat wrought-iron horizontal top and bottom bar, each in one length, of upright round bars of wrought iron, and of the cast-iron ornaments cast on to the same, which here form structural parts of the work, as will be presently understood.

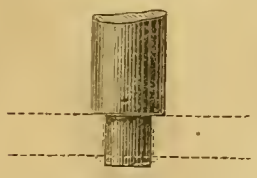
Fig. 4.




In the production of this large quantity of railing, not a single piece of the wrought iron was ever heated or put into the smith's fire. The top and bottom bars were rolled to the right length, and punched cold—the top one with 1¼-inch holes, all to let the vertical bars pass through them; the bottom one with five successive holes of ⅞ diameter, and then one of 1¼ diameter, alternately. The round bars were ordered in two different lengths, five-sixths shorter (about 7½ ft.), and one-sixth of them longer. Every sixth vertical bar passes through both the top and bottom horizontal bars, and for 9 inches into the granite base, into which it is zinco-leaded, the lower end of the vertical bar passing through a hollow cusp, or foot-block, upon the top of which the bottom bar rests. The shorter bars are riveted cold through and at the bottom side of the lower horizontal bar, and pass through the upper one.

To prepare these bars for this, a neck and collar was cut down upon each, as in fig. 5, by a suitable revolving cutter tool. All the vertical bars being prepared and straightened perfectly by hand, the one-sixth longer being mere round bars of the proper length, and the five-sixths shorter with the bottom and neck collars, were then laid into sand moulds, in batches of twelve in one "box;" and the bottom and top ornaments, as shown in figs. 6, 7, being moulded from hollow iron patterns, made to fit the wrought-iron pattern bars, and to keep their proper places and relative distances by means of steady pins, were then "cast on" to them. The patterns for these ornaments, after having been themselves cast from wood patterns, were well chased up. The top ornaments and then the bottom ones of each batch of 12 bars were "poured" simultaneously, and the sand was at once stripped off; the bars being all separately taken out, and the thin "gaits" knocked off, which was all the dressing these ornaments required, or, indeed, admitted of; for though cast from soft gray, Beaufort, No. 2 and Scotch Pig No. 1, they were, by reason of their small relative volume, quite chilled through. Very few broke in cooling; very few were bad castings—and these were broken off from the bar by a blow or two of a hammer, and again others cast on.

Fig 5.

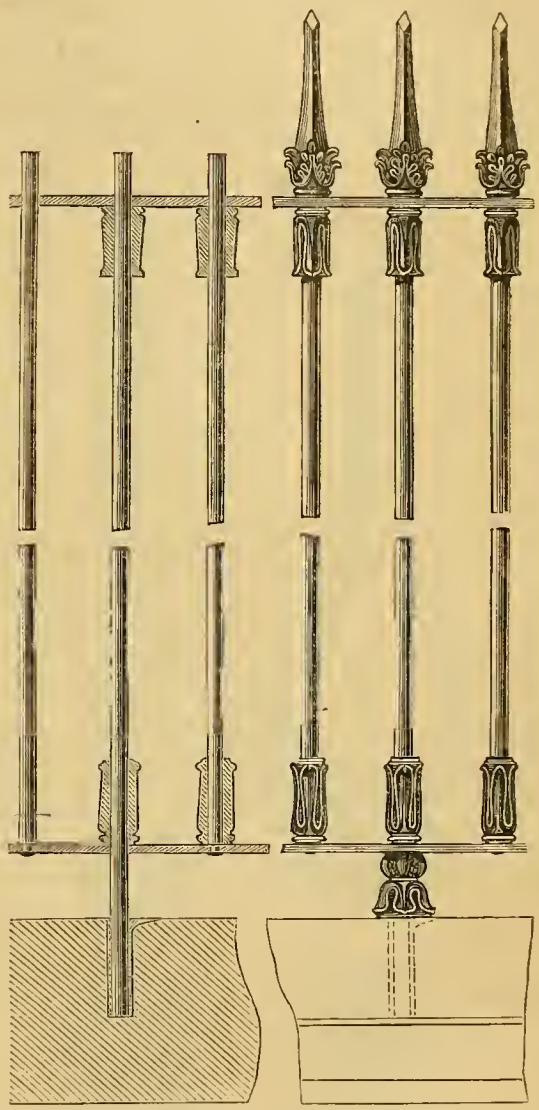


The hollow or open (as to design) halbert heads which complete the railing at top, were cast in green sand, and cored out to drop on loosely to the top ends of the vertical bars, and so admit of being zinco-leaded on to the same.

Now, to erect this railing, the vertical bars were put into position, with the bottom horizontal bar, all laid flat into a wooden framing made to keep them in position and to clamp them so, until the whole sheet was hoisted into place. All the bottom ends of the collared bars were then rivcted to the bottom horizontal bar. The "cusps" being in place over the holes "jumped" into the granite base, the whole sheet and frame was hoisted up by two tackles, and the longer bars dropped through the "cusps" into the holes in the base, the ends of the horizontal bar being inserted into mortices in the pilasters, in which they were held fast, though free to expand and contract within these.

The top horizontal bar was then dropped over the tops of the vertical round bars, until it rested upon the uppermost part of the top "cast-on" ornaments. The halbert heads were then dropped

Fig. 6.



over the projecting tops of the vertical bars; the vertical bars, which were in the holes in the stone base, were zinco-leaded into same; the halbert heads were likewise so secured to the tops of the vertical bars, and then that length of railing was complete. A scroll rear strut corresponding with those of the pilasters was secured at the middle of each length, so that there are thus struts at every five-and-twenty feet or thereabouts. If we have succeeded in making clear to the reader the processes followed, he will have recognised how small was the amount of workmanship expended in the production and erection of this railing. In reality it did not, upon the wrought-iron portion, amount to more than about 40*s.* per ton of the material.

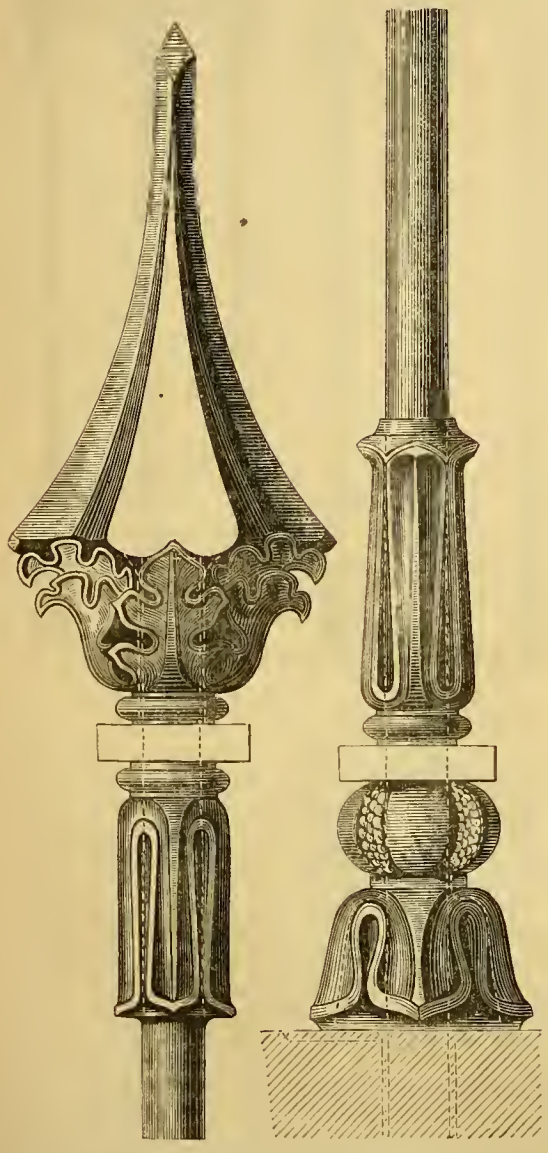
The entire economy here was due to the application of the method of "casting on," for that alone permitted of all the other structural details being carried out.

This railing was constructed in 1843, and the writer believes that the application of the method of "casting on" was then made to *grilles* for the first time. It certainly was so, as far as his own knowledge went and that of the skilled moulders &c. in the employment of his firm, who all at first expressed doubts as to the

practicability of the method, alleging the probability that the ornaments would crack in cooling by contracting upon the practically incompressible wrought-iron bar and so fall off. At first it was proposed to avoid this by coating the places on the bars where the ornaments were to be applied with "clay and black wash," but this proved, as the writer expected, wholly unnecessary. These places on the bars were prepared, however, by brushing them over with chalk and black-lead powder mixed, and this was found, or thought, to make the "cast on" ornaments run rather finer and cleaner.

The line of railing itself is now as good as when erected twenty-six years ago, and is generally deemed one of the handsomest stretches of iron *grille* in Europe. It certainly is much better than anything that London presents.

Fig. 7.



One great advantage resulting from this method of construction is the possibility of dispensing with "leading on" the cast-iron ornaments as commonly practised.

So put on, every lead collar is an electro-negative galvanic element, increasing the tendency of the iron to rust, and causing the corrosion to be local and locally powerful. With many designs it would be practicable to dispense with the use of "cramping" or leading altogether. With that we have described this might have been done, at a little greater expense.

The writer, however, had proved experimentally that an alloy of zinc and of lead may be formed, whose galvanic relations to iron are much more nearly those of zinc itself to iron, than those of lead to that metal, and in fact such as not to cause any fear from its local increase of corrosion on the iron of railing.

This alloy he adopted in place of lead, for what he has called the zinco-leading or "cramping" together, and the result has justified his experimental previsions, for after twenty-six years, and not more than four coats of dark green paint during the time, there are no signs of local corrosion whatever.

Zinc itself would be best of all as a "cramping" metal, but it runs too thick and drossy to form a close or safe junction.

In some ornamental railing recently erected at Westminster the uprights are secured without leading to the granite by iron studs and screws and by Portland cement. This is, however, a bad plan; one may say "out of the frying-pan into the fire," for the bond of the thin plate of Portland cement is certain to be broken by the expansion and contraction of the metal, and then water will find its way in by capillarity, rust will form between, this will, as usual, expand in volume as compared with that of the metal from which it has been produced; and the railing will be lifted up or the base claws broken by it, or by the expansion of water frozen between the joints which it shall have entered.

The points upon which we have here been treating are wholly those of the practical ironfounder, and of the founder in one of his humblest capacities, namely, as the servant of the architect and builder. It is to be hoped that enough has been put before the reader interested in the founder's art, however, to impress upon his mind the advantages he may occasionally derive from the method of "casting on," and to indicate the cases in which and why it should be shunned, and also some of those in which it may be employed with a value and profit proportionate to the skill devoted to its special adaptation.—Ed.

## LORD JOHN HAY'S IMPROVED ENGINE COUNTER.

(*Illustrated by Plate* 2.)

The mechanical apparatus shown in plate 2 is an arrangement for indicating and registering the number of revolutions of engines running at high velocities, and is the invention of Captain Lord John Hay, R.N. In June 1864 his Lordship obtained Letters Patent for an ingenious apparatus for varying autograph stamps, with a view of preventing forgery as far as possible, as well as rendering its detection easy and certain. The patentee shortly afterwards (December 1864) obtained another grant of Letters Patent in which the autograph stamp is combined with a self-acting registering or numbering apparatus. In this modification of the original mechanism the lever which connects the registering apparatus to the particular machine whose movements it is intended to record or number operates upon the ratchet wheel during only one half of any complete vibration, or one half of a corresponding revolution of the machine; while, during the other half, the registering wheels are stationary. The end of the pawl is, meanwhile, retreating over the points of the teeth of the ratchet wheel, which is prevented from moving backwards by the bending of the pawl as it passes over the inclined faces of the teeth; as also of the spring catch gearing into the notches on the side of the unit wheel. Thus the ratchet and registering wheels are in motion only during one half of the time occupied in recording any given number of revolutions, and consequently, while at work, those parts move at double the velocity that would suffice were the motion continuous.

The necessity of avoiding any superfluous velocity in the registering wheels, arising from the additional momentum thus imparted to those parts having a tendency to carry them past their proper positions; and the advantage of employing a form of ratchet motion that requires no elasticity or spring in or about the pawl, or on the unit wheel, when applied to steam-engines or machines moving at great speeds, will be obvious; while the expense of gearing the unit wheel of the apparatus to any machine whose only revolving part is of large diameter, such as the crank shaft of a steam engine, by any direct rotative agent with safe action would in many cases exceed the cost of the counter itself.

According to the present modification, a peculiar combination of levers in connection with a ratchet wheel is employed for the fol-

lowing purposes :—1st. To impart a progressive motion to the registering wheels, while the actuating lever is moving in either direction. 2nd. To avoid the necessity of flexibility in the pawl, or the use of a spring in any form, for ensuring contact between the pawl and ratchet wheel. 3rd. To avoid the use of a spring detent on the unit wheel, which, having to vibrate once for every revolution, or stroke, of the crank shaft, or other moving part, is liable at high speeds to rapid destruction.

Referring to plate 2, fig. 1 represents a transverse section with the end of the cover and ratchet motion removed ; and fig. 2 is a horizontal section of the apparatus when employed as a steam-engine counter.

Fig. 3 is a front view of the apparatus, with its casing complete.

Figs. 4, 5, and 6 represent the improved ratchet motion; and the mode of applying it to work the registering apparatus.

Fig. 7 is a series of illustrative diagrams, which show the positions of the several levers or parts of the motion, and the pivots or centres upon which they turn at the beginning and end of each stroke or half-vibration of the actuating lever. Thus the lines A *b*, *b* c, c *d*, and *d* E, diagram No. 3, and A *b'*, *b'c'*, *c'd'*, and *d'*E, No. 2, correspond to the positions of that combination of levers which, for convenience, may be denominated the lower group of levers, at their initial and terminal positions. The lines A B, B C, C D, and D E, diagrams No. 1, and A B', B'C', C'D, and D E, No. 4, correspond to the positions of the upper group, at their initial and terminal positions.

Referring to figs. 2 and 6,—z is a ratchet wheel of ten teeth, fitted on to a projecting boss on the unit wheel, so that the two move simultaneously, and A B', A *b* are two levers, also fitted on the boss of the unit wheel, one on each side of the wheel, but free to revolve upon it. The outer ends B' and *b* of these levers are jointed to the ends of the pawls *e*, c', B', c, c, *b* ; on the axle E is fitted a two-armed lever, with its upper arm connected by the pivot D to the lever C' D, and its lower arm connected by the pivot *d* to the lever c *d*. These two levers are in turn connected to the pawls at their other extremities by the pivots C' and *c* ; the ends of the pawls *e* and *e*, projecting beyond these pivots, engage the driving faces of the teeth of the ratchet wheel. It may be here observed that the actuating lever is not shown, it being dependent as to form and dimensions upon the particular description of engine or machine to which the registering apparatus is intended to be attached.

Suppose the actuating lever to be moving the axle E, diagram 3, fig. 7, through the angle E, *d*, *f* ; its force in the lower group of levers will be transmitted through the pivot *d* to the middle of the pawl at *c*, in the direction *d* c, and from thence to the pivot *b* at the end of the lever A *b* ; but the pawl being moveable on the pivots *c* and *b*, the force acting in the direction *d* c will first tend to turn the pawl upon *b*, pressing its outer end *e* down on to the wheel. The two ends of the pawl being thus supported by the pivot *b* and the wheel, it may be considered for the remainder of the stroke as being of one piece with the lever A *b*, with a new line of action A c, and moveable only on the centres A and c. The motion at c is now transmitted to A, and the end of the pawl *e* gearing with the driving face of the tooth of the ratchet wheel, this latter is carried round, and with it the unit wheel, until the actuating lever has arrived at its terminal position in that direction, when the point *d* will have arrived at *f*, and this group of levers will occupy the positions shown at fig. 4, or more clearly by the diagram No. 2, fig. 7. While the lower group of levers has been moving from its initial to its terminal position, carrying with it the ratchet wheel as described, the upper group has been moving downwards from its terminal to its initial position. In this case the force of the actuating lever is transmitted through the pivot D to the centre of the pawl at C' in the direction C' D, and from thence to the pivot B', at the end of the lever A B' ; but the angle D C' B' on one side of the pawl, being less obtuse than the angle A B' C' on the other side, and the end *e* of the pawl being supported on the wheel, the force acting in the direction C' D will turn the lever A B' on the centre A, and the outer end *e* of the pawl will be pressed on to the wheel with a force varying in amount proportionally to these angles, diminishing as the angle D C' B' increases ; but as the angle A B' C' at the termination of the movement in this direction, is still greater than D C' B', the force acting on B' in any direction, which C' B' can assume, as due to the altered positions of C' D and A B', will not tend to turn the pawl on B', and the slight angular movement of the pawl—equal only to the depth of the teeth on the ratchet wheel—is effected by the rotation of the wheel advancing the inclined face of the tooth under it. The upper group of levers have the same amount of angular motion on the axles A and E as the lower group ; and when the latter has arrived at the position shown at diagram 2, fig. 7, or when the actuating lever has moved the lower arm on the axle E through the angle E *d f*, No. 3, the corresponding positions of the upper group, due to the equal vibration of the upper arm on the axle E through the angle E D F', will be as represented at diagram 1, fig. 7.

It will be observed that while the lower arm *d* of the lever on E has been moving the ratchet wheel forward in the manner described, through the one-twentieth of a revolution plus the small amount of clearance at the beginning of the stroke as shown by its vibration through the angle E *d f*, the upper arm of the lever D has moved the end of the pawl *e* C' B' backwards through an equal distance, or the two pawls have together moved a little over one-tenth of the ratchet wheel's circumference ; and this pawl is now ready to engage the next tooth in succession of the wheel, as shown by the dotted lines in the diagrams fig. 7.

The actuating lever now moves the reverse way to the position it occupied at starting, carrying the arms D and *d* on the axle E back again through the angles E D F and E *d' f*, and the pawl *e* C' B' carries the ratchet wheel forward, while the pawl *e c' b'* returns to its former position, ready to engage the next tooth in succession ; but as the forward motion of the upper group of levers is precisely similar in its action and effect to the forward motion of the lower group, and also the backward motion of the lower group being similar to the backward motion of the upper group, both of which have been described, it is unnecessary to follow the particular changes of position in detail, only observing that on the completion of the motion of the vibrating lever in this direction the two groups of levers will occupy their original position at starting ; the engine or machine to which the apparatus is attached will have completed one revolution and the unit wheel will have been carried round one-tenth of a revolution.

By adopting suitable proportions in the parts of the groups of levers, any amount of grip on the ratchet wheel may be obtained ; but the patentee prefers the proportions shown, and to fix the counter, to work, with the line of centres of the axles A and E, in a horizontal position, or between that and 30 degrees with the vertical ; so that the weight of each group of levers may co-operate with their gripping action, in ensuring a safe hold of the ratchet wheel. These counters have, we are informed, been thoroughly tested for speed and endurance, at Woolwich Dockyard, at the rate of 18 and upwards, to 450 revolutions per minute, and have been highly commended for their durability, absolute accuracy of registration, and simplicity of construction.

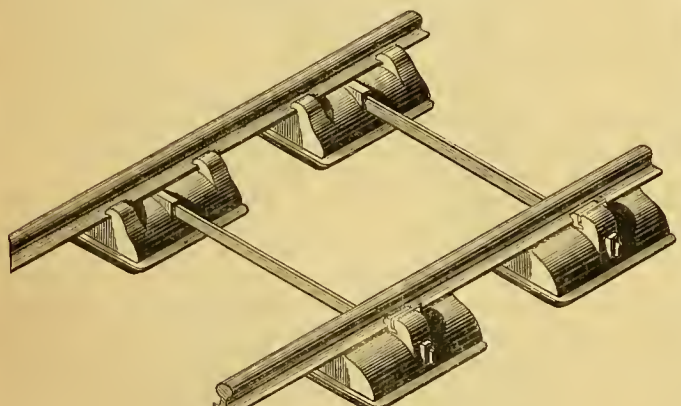
## IRON SLEEPERS FOR THE FLANGE RAIL.

The chief argument in favour of iron bearers for the rails of permanent way is the greater durability of metal as compared with timber. The proposal to use wrought iron, in various forms and modes of arrangement, for this purpose, carries the argument of durability only half-way to its legitimate conclusion. The rapid corrosion and waste of substance of natural-surfaced wrought iron, especially in climates characterised by wide thermometric and hygrometric ranges, renders it little less perishable than good hard timber or thoroughly creosoted pine. It is, moreover, evident that no system of wrought-iron bearers can be applied to any section of rail which does not involve either riveting, or bolts and nuts, or both, as well as complication of fastenings to hold the rail itself. For all practical purposes, therefore, wrought iron as the chief element in the substructure of the road may be considered inapplicable. The majority of engineers who have endeavoured to solve the problem of making the track all in iron have, therefore, on rational grounds, adopted cast iron as the material. The natural "skin" of cast iron resists corrosion for a long period, even in

unfavourable situations. The facility with which projections of a required form can be cast on a sleeper for assisting to hold the rail gives it at once a further advantage of immense value over its kindred material. As such projections cannot be got in rolled iron, and would be enormously costly if stamped, the only alternative, in a wrought-iron bearer, is to multiply the number of separate parts, adding continued complication to the whole structure.

Of the three best known forms of cast-iron sleeper, the first, from its bowl-like form, is essentially unstable ; the second has the metal distributed in a manner so contrary to its nature that the sleeper constantly fails by breakage down the centre ; whilst the most recent is merely the first inverted. The sleepers have been, moreover, hitherto primarily designed for the D H rail, which is little used abroad, and is going out of fashion at home. The want has, therefore, for some time been felt of an iron sleeper applicable, without bolts and nuts or other objectionable or complicated fastenings, to the flange, or Vignoles, rail. Supposing a D H rail to be held by a key driven between jaws (the ordinary plan and the best), it is clear that initial tension of the sleeper is induced on driving the key ; so that, unless there be sufficient thickness of metal, a small increment of strain will sometimes cause fracture. It is equally clear that the form of the flange-rail permits of its so lying on the crown of a sleeper of curved section as that the body of the sleeper shall be always in compression. It follows that, for this rail, a stronger sleeper may be made with less weight of metal.

The accompanying figure is an illustration (in isometric perspective) of the system of permanent way now adopted by Mr. Cockburn Muir. The plan appears to avoid the defects of the present methods, while it meets all the requirements of a good road, with the capability of application to light or heavy traffic. The sleeper is in plan a parallelogram, the figure which gives the largest bearing surface with the greatest stability. The corners and angles are well rounded, so as to ensure a clear flow of the metal in the mould. The transverse section is a semi-ellipse, of such a ratio as

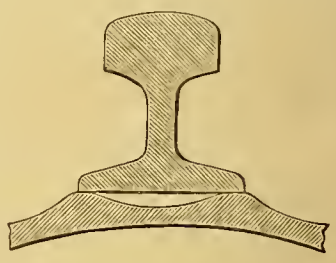


to give the necessary convexity for strength, without undue height. In the line of axis of the curve is a horizontal flange, to correct the tendency in a curved sleeper to "rock." This flange runs round the exterior of the sleeper, so as not to interfere either with packing or with the flow of the metal. The curved portion is continued downwards below the flange to give a vertical "knife-edge," to prevent slipping in the ballast, and ensure perfect grip. The tie-bar is passed through a long open socket in the sleeper, and secured below the rail, so that the fastenings cannot be readily tampered with.

The rail lies upon the crown, but not, as with other systems, along the central axis of the sleeper. In order to obtain a greater mass of the sleeper and its contained ballast without than within the rail, to resist the diagonal strain incident from the travelling load, the centre of the rail is set at the point, within the centre line of the sleeper, where a plane inclined at about one in twenty to the horizon touches the exterior curve. This arrangement also gives the required tilt to the rail, without that thickening of the metal on one side which tends to produce unsound castings.

When the rail is set on the axis of the sleeper, it is evident that a greater mass must lie within than without, the resultant of the vertical and lateral strains, so that the tendency of the gauge to open at high speeds, or in running down hill, when oscillation is at the maximum, is rather assisted than corrected. This, however, is on the supposition that the ordinary conical tyres are used. In a recent paper on "Light Railways," read before the Royal Society of Arts at Edinburgh, Mr. Cockburn Muir strongly advocated the use of rolling stock with flexible wheel-base (on Fidler's plan of radiating axles). We may, therefore, assume that he would make the tyres cylindrical ; in which case the rail would not require tilt, as lateral strain, even on curves, would be practically eliminated.

It is generally assumed, though we believe with little foundation in fact, that a road laid with cast-iron sleepers must be hard and rigid. The idea no doubt has its origin in the results of various systems of track in which there is a *continuous* bearing of wrought iron under the rail. Hence attempts have been made to secure a certain elasticity by the interposition of wood cushions. We know, however, by varied experience, that such cushions become in a short time so compressed as to be quite inefficient for the absorption of vibration. Cork is probably the only material which, being permanently elastic and sufficiently durable, would quite answer the purpose. But in view of the sizes required, and nicety of form, its cost places it out of practical consideration. Moreover, there is the almost insurmountable practical difficulty of compensating, in the fixed fastenings of the rail, for the recession of the yielding cushion under the load. On what appears to be the well-founded assumption, that all that is absolutely needed is to minimise the amount of contact between the surfaces of the rail-foot and the crown of the sleeper, Mr. Muir casts two fillets along the latter, on which a part of the rail-foot at each side takes a bearing, so that under the centre of the rail a hollow space is left as shown in the annexed figure. The result is that there is no direct reaction from the centre of the sleeper to pressure or blows in the direction of the axis of the rail. The effect of the elevation of the rail in this manner is to deflect the strains from the centre towards the sides ; and as the central surfaces are not in contact, it is clear that vibration between them is counteracted. This is equivalent to a reduction of rigidity ; because the surface of the track being far from a "perfect plane," and the vibrations being chiefly due to impacts against inequalities in the surface, the reaction of the rigid sleeper to these impacts is partially absorbed in the hollow space by the slight yielding of the rail-foot.



The danger arising from initial tension where a D H rail is held by a wedge-key in the usual manner is very much magnified in the case of a flange-rail, especially when the width of the flange or foot considerably exceeds that of the head—as in most sections it does. Because, in view of the necessary clearance for the insertion of the foot, either the jaw for retaining the key must form an ugly protuberance on the sleeper, or the key must be so many-sided or so irregular in section as to bring about a certainty of its driving foul, and necessitate great thickness of jaw to resist abnormal strain. The system we have illustrated avoids these inconveniences by the adoption of a loose clamping-piece or clip of a section easily rolled, which takes the side of the rail opposite the lips which are cast on the sleeper. The clip is brought home by a taper-key of small dimensions, the angles of whose sides evince careful consideration of the problem how to obtain a maximum hold for the rail with the minimum of strain on the jaw. The effect is to remove all tension from the body of the sleeper and leave very little on the jaw itself, as the fastening is outside the rail.

The *rationale* of Mr. Muir's system so completely covers the practical application of cast iron to sleepers, that we think the remarks we have devoted to it cannot fail to interest technical men, at a time when every energy is being directed to improved efficiency and greater economy in construction of railway appurtenances. If we are to meet the requirements of new districts now opening up

for railway enterprise, where the capital to be expended is insufficient for the costly methods we have hitherto followed, we must evidently study a careful adjustment of means to ends. One palpable advantage of cast-iron sleepers, taking into account the greatly increased bearing we can obtain for the rail, is the facility afforded for reducing the weight of the rail by increasing proportionally the strength of the substructure composed of a cheaper material.

## ROTATORY COAL-CUTTING MACHINE.

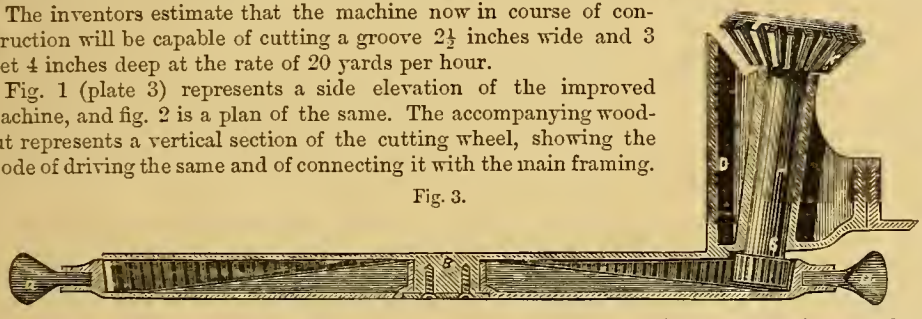
*(Illustrated by Plate 3.)*

The Rotatory Coal-Cutting Machine which we illustrate by plate 3 is the combined invention of Mr. John Gillott, of Chapeltown, and Mr. Peter Copley, of Warren, Yorkshire. These gentlemen have for some time past directed their attention to the discovery of a simple and practical mode of applying rotatory cutters for "holeing in" the bottoms of the faces of coal workings, and have at length solved the problem in a satisfactory manner. The advantages obtained by the use of a series of rotatory cutters in substitution for single reciprocating tools are, an increase in the work done in a given time without increasing the speed of the machine, by reason of there being no loss of time incurred during the return stroke of the cutter, as is the case when using reciprocating cutters. The cutters, moreover, have more time to cool before re-entering the cut, and the use of rails laid along the face of the working for the machine to travel upon is entirely dispensed with.

The inventors estimate that the machine now in course of construction will be capable of cutting a groove 2½ inches wide and 3 feet 4 inches deep at the rate of 20 yards per hour.

Fig. 1 (plate 3) represents a side elevation of the improved machine, and fig. 2 is a plan of the same. The accompanying woodcut represents a vertical section of the cutting wheel, showing the mode of driving the same and of connecting it with the main framing.

Fig. 3.



A is a horizontal cutting wheel or disc of cast iron, in the periphery of which are mounted in sockets a number of cutters *a*, of any suitable form. This disc revolves round a stationary centre or boss B fitted to or formed on the under side of a covering plate C, which plate is bolted to the under side of the fence bracket D. The bracket D is itself bolted to the bed plate E of the compressed air-engine which is mounted on travelling wheels F.

The cutter wheel A has internal cog teeth made therein, as shown in fig. 2, where a portion of the covered plate is broken away in order to expose the teeth. In these teeth gears a spur pinion G, fast on the lower end of a short upright shaft H, working in a long bearing I, cast in the fence bracket. On the upper end of the shaft H there is keyed a bevel wheel K, into which gears a corresponding bevel wheel L fast on the driving shaft M. This shaft works in suitable bearings in the standards N, and has keyed upon it the spur wheel O, which derives its motion from the pinion P, fast on the crank shaft Q of the engine. The crank shaft may be driven by any convenient prime mover, but the inventors prefer to employ a compressed air-engine, of which R R represent the two oscillating cylinders. It will thus be seen that on starting the engine a slow but powerful rotatory motion will be imparted to the cutter wheel or disc A, the cutters *a* cutting or scooping out the coal, stone, or other mineral from the bottom of the groove outwards or towards the face or front of the working. During this action of the cutters the entire machine is caused to travel slowly along, in order to keep the cutters well up to their work. This feed motion is derived from the endless screw S on the shaft M gearing into a horizontal worm wheel T, fast on a short vertical spindle working in a collar bearing U in the bed plate, and carrying at its lower end a horizontal chain pulley V which gears into the chain W. The rear end of this chain is left free after first passing round or being returned over the guide pulley V, as shown in dotted lines in fig. 2, but its forward end is anchored some distance ahead of the machine, being first guided over a front guide-roller (not shown in the engravings) mounted on the united ends of a tension rod Y and a rigid T-iron bar Z, which project from the front end of the machine. The object of thus guiding the chain along which the machine hauls itself forward is to keep the machine well up to its work, by resisting the tendency it has to revolve round the centre of the cutting wheel or disc.

## THE CANDLE MANUFACTURE OF THE PRESENT DAY.
### PRICE'S PATENT CANDLE WORKS, BATTERSEA.

We remarked some time ago, in reviewing Turgan's *Usines de France*, what an almost boundless field for a similar but greater work the great manufactories of Britain would present.

In the absence of any comprehensive history of British workshops and manufactories, none but those whose avocations or privilege enable them to visit these very widely, and with the advantage of much and various preliminary knowledge, have any adequate idea of the prodigious amount of scientific knowledge and technical directive skill that is scattered everywhere up and down our land; nor of the often unexpected power and information to be met with in the persons of principals, managers, and even workmen engaged in our numberless industries dependent on mechanics, physics, and chemistry, singly or combined.

But although this is so, it is not the less true, that in Great Britain our working hands are on the whole almost brutishly ignorant, that primary education is their great want; and that the leaders of skilled labour, in every class, sort, and degree, greatly stand in need of better technical education and of better means towards attaining it. For the science—even the knowledge—one meets with in these instances is too often, almost always indeed, unsymmetric, one-sided, partial; often so fragmentary and lighted up at a single point only, that practically most wanted, as to resemble in some degree the skill (without any science) which directed traditionally the arts and manufactures of the Egyptians of old, or of the Chinese of fifty years ago.

In none of the crowd of British industries is there perhaps more real knowledge amongst the leaders than in those of our chemical and chemico-metallic manufactures; and in this large class probably none that present evidences of greater and more advanced knowledge, or are of more general interest in their scientific aspect, than that which was once the very humble art of making candles.

The manufacture itself is quite one belonging to the Northern nations: to Asiatics, Egyptians, Greeks, Romans, Spaniards, and Southern French the candle was always an unknown commodity, except in the form of the wax-lights, which from the costliness of their material were and are the votive offerings of the church, or the expensive illuminants of the exclusive assemblies of the opulent. Nature supplied in abundance many liquid oils, and as nature gave them these were burned, in wick'd earthen or metal lamps. The Northern nations, deprived by climate of most natural oils, were driven to solid substitutes, and slowly evolved the candle formed of animal fats from the splinter of pitch pine-wood which lighted fitfully the rude halls of the Norseman, the Briton, and the Teuton.

The Esquimaux alone—by the singular accident that the fat of the *cetaceæ* which formed his only fuel for light and for heat, is by the economy of the Arctic animal half-liquid—improved upon the very same track as the refined and civilised Egyptian or Greek, and formed his lamp of nature's pottery, potstone or steatite, in place of the clay, which he could not bake for want of fuel.

It was wonderful alike, how long and slow was the march of improvement in the candle, which forty years back was much in the same state that it had been four hundred years before; and when once the road to improvement became clearly indicated, how rapid and complete has been the transformation which candle-making has undergone, and how from being the "chandler's" very humble trade, it has grown to be one of our largest, most refined, and elegant branches of chemico-mechanical manufacture. The real starting-point of all this is to be found in two facts: the

development of the true chemical history of the oily bodies by the labours of several chemists, but mainly due to Chevreul; and the opening up the trade in Palm oil from the western coast of Africa by the energy of Liverpool merchants.

It is not fifty years yet since the first consignment of Palm oil reached Liverpool, and for some years it was deemed a curious but worthless product—one for which no one could suggest any extended use.

We cannot afford space to trace the history of the many methods, patented or otherwise, that in the interval have been more or less employed to make this oil useful as a material for candle and soap-making. Some of these are still in use abroad, if not in this country; but that which, if it has not superseded, has exceeded in extent of application all others, is that employed by the Price's Patent Candle Company (Limited) at their vast works at Battersea—works at present, no doubt, the largest in the world engaged upon a like industry. Their operations are by no means confined to Palm oil and Cocoa-nut oil, but the former may be viewed as the great staple raw material of their works. As imported from the coast of Guinea chiefly, the Palm oil, the product not only of the pericarp of the seeds of the *Elaïs* but of that of several other species of palm, is a fat at 50° Fahr. of about the consistence of butter, of various tints of orange or brown, and having a strong odour, something like that of violets, tainted by some unknown rancid smell.

This comes from its colouring matter; and the object of the operations to which it is subjected at Battersea is to separate the crude fat into its three proximate constituents, viz., this colouring and fragrant matter, solid stearine, and a liquid oil or olein; and in doing so to eliminate a fourth substance, once deemed, like the oil itself, of no value, but now of varied and important uses, namely, *glycerine*, formerly called the "sweet principle" or "sugar of oils." We must presuppose some acquaintance on the part of our readers with the chemistry of the oils, for we cannot begin with the Creation, and purpose here merely a rapid sketch of what is done, and how, in Price's great manufactory.

Incidentally we may mention that, although we were privileged to examine every part of these works not long since, through the courtesy of one of the founders and partners, and with the advantage of the admirable running commentary and exposition of the scientific and able general manager of the works; we believe that no obstacle would be found to the visit of any one whose antecedents proved him worthy of the privilege, and not a mere vacant idler; for, like almost all really great and successful concerns, they disclaim having any secrets, however much there is for the chemist and chemical manufacturer to learn, and great as is the lesson afforded to the reflective manufacturer, whatever may be his speciality, by the inspection of this admirably well-ordered and skilfully-arranged and conducted work, or rather congeries of works.

The crude palm oil—barged up the river and into the Company's docks—enters the works in large hogsheads. These are rolled into a huge shed and placed in ranges over large tanks, with the bung-holes open and downwards; a steam-pipe is introduced into each bung-hole, and the nearly solid fat is melted clean out of the cask and runs into the tank. In this it is kept liquid by steam, and thence is pumped up into large vats, in which it is mixed with a certain proportion (about 6 per cent.) of sulphuric acid, which is thoroughly incorporated with its mass; the latter being kept at a temperature of about 360° Fahr. by means of superheated steam passed through coils of pipes in the interior of the vats.

After this treatment, the oil is no longer orange, but of a dirty sooty black, and its odour quite changed; in fact, the colouring matter has been carbonised in part, and the odorous principle destroyed.

There is no doubt but that, could the odoriferous principle be preserved unaltered and separated without too great cost, it would prove a highly valuable matter to the perfumer, and indeed might prove the base for a whole tribe of new and valuable organic compounds.

Some attempts, but none of an exhaustive or persistent character, have been made to effect this, but so far without success. The problem remains open to reward the skill of some organic chemist.

The oil, after the above treatment, is washed with boiling and slightly acidulated water, aided by steam, blown through to agitate it; then washed in pure water, to free it from acid; covered up, and left to repose.

This crude material is now pumped up into large copper stills, in which, partly by fire-heat, but mainly by superheated steam, it is raised to a temperature of about 550° or 600° Fahr., steam constantly blowing through it, but air being carefully excluded. Along with the steam, the oily (acids) distil over at 400° and are condensed in vertical condensers, kept above the boiling-point of water, in which the oils or fats condense; while the water vapour passes on and is finally condensed, parting with any traces of fat it may have carried on with it.

The material now, when at common temperature, is a dull yellowish fat, which may be made at once into common composite candles; but to form the finest qualities of these, and such as will bear being burnt in tropical climates, this crude fat must be separated mechanically into its liquid and solid constituents, olein and stearine. Spread like butter in thick layers upon cloths formed of very strong and peculiarly woven woollen, it is exposed to great pressure (as in pressing oil-cake) by means of many hydraulic presses.

These have horizontal cylinders, and all the tables and parts about the pressing parts are maintained by steam-pipes at about a temperature of 120° Fahr. The liquid oil drips down into cisterns, the solid is separated, and found between the woollen surfaces in the form of glistening white crystalline cakes, hard, and which when knocked together sound like wood, and which scarcely grease the finger. This is the stearine, from which the best candles are made.

Returning to the stills which we just left. After the distillation has been pushed to its conclusion, there remains in the still a dark black residue, or pitch, possessing most of the properties of bitumen, and some peculiar to itself. This is sold for the same uses as common pitch; its worst portions are, we believe, used as fuel.

Let us now pursue the stearine. These white cakes are melted again by steam in vats, washed, purified, occasionally subjected to further pressure, and at last assume the most perfect form of a fat, solid—perfectly white, scarcely unctuous to the touch, and perfectly homogeneous at common temperature, and of a perfectly colourless oil at 120° Fahr. or upwards.

It is liquefied and pumped into vats kept at this temperature, and as little exposed to dust or air as possible, in the moulding room. In this vast shed, lighted as are nearly all the buildings in the works—which as a precaution against fire, in view of the extremely combustible materials dealt with, are as much as possible isolated, all of one storey and all of iron and brick—are arranged in long parallel rows the prodigious array of mechanically-acting moulding machines, by which with very little human labour candles are produced in millions.

Each range of moulding machines consists of a long frame, transverse to which are the pewter candle moulds fixed vertically in groups of eighteen each.

A light railway on top enables the larger tin-plate cistern with its peculiar distributing lip and valve at bottom of one side—which carries the liquid stearine from the store vat in which it is kept warm at the end of the range, and brings it successively over each iron range of eighteen moulds—to be filled. Close beside each set of moulds, are fixed on axes, when dropped into these places, as many bobbins of cotton wick as there are single candle moulds.

The wick is drawn up through the small hole in the bottom of each candle mould, which it thus sufficiently stops. The upper or loose end is passed between the overlapping ends of a brass ring, like the split-ring of a bunch of keys, about $\frac{7}{8}$ inch in diameter, and by which it is held central, and at the mouth of the mould and above the bottom of the future candle.

All the 18 rings are in plane transverse to the line of candle moulds, or *in directum* with the range of all these. To every mould is laid on steam, cold water, and compressed air, with suitable stopcocks to each. The stearine-can rolls along and fills 18 moulds at each stoppage, covering up all the wick rings in the parallelopiped of stearine, which fills the little trough, one side of which is movable, and whose bottom is in the same horizontal plane with that of the future candle.

As soon as the stearine is set sufficiently in the moulds, but still liquid or partly so in the trough, a boy goes along with a peculiar instrument armed with 18 hooks; he threads these at one stroke through the 18 brass wick rings, and lifts them all out, leaving the wicks, the ends of which slip through the split rings, fast gripped in the colder candle beneath. Cold water is now turned on round the moulds, and the candles become quite solid. A simple but beautiful mechanical arrangement cuts off all the superfluous stearine above the bottom of the candles (which are here uppermost) and the superfluous bits of wick also. The candles are now to be extracted. If the season or other circumstances need it, steam is for an instant blown round the moulds and shut off again, at the same instant that compressed air is turned into the lowest part of the mould; the candle is thus blown up out of the mould sufficiently for the puff of air to escape, and for the candles to be seized and withdrawn, and gathered into baskets by boys who go along for the purpose.

In drawing out the candle, the continuous wick for the next one to be made, is drawn up through the mould, and being cut off from the top of the candle just completed, leaving enough projecting for lighting, that is in turn fastened by the brass split ring, ready for the next; and so the process is repeated. Each candle comes out finished and complete, quite clean and square at bottom, and needing nothing but packing into bundles before going out for sale.

They leave the moulding room in masses, and checked by weight only, and reach the separate packing-room, where boys with the marvellous adroitness which practice gives, and aided by well-contrived wood hollow seats or moulds consisting of three sides of a hexagon (dependent on the fact that equal cylinders and parallel pack together into hexagonal prisms), collect the different denominations of candles into faggots or bundles of one or two dozen each, and tie them with tape, or enfold them in paper as may be desired.

Paraffine candles are also largely made at these works, to which we shall refer again. These are moulded in the same way as the above, but from the superior hardness and brittleness of paraffine over stearine, the bottoms of these candles require to be trimmed. This is done by sawing-off a small portion of the lower end of each. by means of a fine and rapidly revolving circular saw. A dozen candles or so, laid into semicylindrical grooves pass before the face of the saw automatically, and so that all the candles are precisely of the same length and weight.

Weighing is dispensed with at every stage of the manufacture after the moulding, and stock accounts are kept by number, whence the weights are inferred. Every department has its own head, with its own set of order and delivery books, and stock books; and the printed orders for the trade whether domestic or foreign, pass regularly to the packing rooms from the central office, which interprets between the hive of industry within and the public, and in return the order goes out, and printed receipt dockets are returned to the superintendent packer as his voucher for so much delivered from the stock under his charge.

Ancillary to the candle-making departments is a small cotton mill, for the production of the cotton wicks and for the reeling those on the spools or bobbins to go to the moulding rooms. The wicks are *plaited*, not twisted, and the peculiarity of this formation is, that in burning, the wick turns off always to one side, so that its extremity is exposed at the outside of the flame, as we all observe in seeing stearine candles burnt, by which that part is burnt completely to ashes, and so snuffing is unnecessary.

The reason of this is the unequal shortening, produced by the filling of the strands of a plaited wick by capillarity with the liquid stearine, at the top of the burning candle.

A dry rope, as all know, is shortened and caused to twist by wetting it with water; an old-fashioned *twisted* cotton wick did the same when wetted with melted tallow; but a wick plaited in three strands, in any one of several ways, has a longer strand or one more tightly compressed at one side than at the other of a given length; and thus when wetted with melted stearine, the wick as a whole shortens unequally, and so bends over to one side.

Besides this there are other adjuncts, in a special factory devoted to the making of the cases and boxes in which these candles are sent abroad, and in which those also for other departments of the works are fabricated.

We must defer our further description, however, to another part.

## SCREW-CUTTING MACHINERY.

(*Illustrated by Plate* 4.)

A WANT has long existed in engineering shops and factories of an apparatus susceptible of ready adjustment for cutting screws of any required pitch. A mechanic called in to repair a machine has usually only one set of taps and dies at his disposal, consequently his operations are limited, and he is occasionally compelled to deface the parts entrusted to him in order to adapt his own screws to them.

The improvements in this class of machinery recently introduced by M. de Résener of Paris comprise cheap and simple arrangements whereby screws can be cut at a moment's notice to any desired pitch.

The chief feature in M. de Résener's apparatus is an inclined plane, the angle of which has simply to be varied in order to produce the particular pitch of screw required.

This adjustable incline may be applied to a great variety of machine tools without necessitating their undergoing any important modifications.

The adjustable incline is represented on plate 4 as being applied to a screwing machine of a somewhat similar arrangement to that of a lathe.

Fig. 1 is an external elevation and partial section, and fig. 2 a corresponding plan of a lathe, to which the inclined plane is adapted for screw-cutting purposes. Fig. 3 is a transverse vertical section; fig. 4 is an end elevation of the driving gear detached, and figs. 5 and 6 are detail views showing the adjustable inclined plane.

The machine is composed of a frame A carrying the whole of the mechanism, a slide rest B, the back centre C, and the adjustable inclined plane D. The main shaft E, which may be turned by hand by means of the handle *e*, carrries the cone gearing G and a chuck plate H. An intermediate shaft I carrying corresponding gearing G′ actuates the lower spindle J through the intervention of the wheels *i* and *j*. On the spindle J there is mounted a pinion $c^2$, which gears with one of two racks *c c′* in connection with the adjustable incline D.

The adjustable incline (figs. 5 and 6) consists of a U-shaped bar hinged at *d* to another U-shaped bar or guide D′ carrying the racks *c c′* on its upper and under surface. At the end opposite to the hinge these two bars D and D′ are connected together by a screw *o* fixed at *o′* and passing through the adjustable incline D. The screw *o* is provided on each side of the incline with a milled headed nut, so that the distance betwcen the inclined plane D and the bar D′ may be increased or diminished as required. The inclined plane thus arranged is mounted in a fixed guide A′ (fig. 1) formed in the frame A, so that one of the racks *c′* will be in gear with the pinion $c^2$ on the spindle J. The inclined plane D acts on the slide rest B in the following manner:—The slide rest has a socket cast upon it, in which is fitted the shank of a roller-carrier L, the roller *l* of which is in contact with the inclined plane; as the position of the roller has to be altered for each different pitch of screw, the carrier L is made adjustable, and is maintained in its place by a gripping ring provided with a tail-piece having a screw thread formed on it, which is secured by means of the hand nut N. The counter weight N′ tends constantly to draw the roller carrier L with the slide rest B in such a direction as that the roller *l* may be always in contact with the face of the inclined plane D. A small intervening space separates the two sets of gearing G and G′, which can only operate through the intervention of the intermediate pinion *g*, mounted in an adjustable arm or carrier $g^1$, shown in fig. 4, which may be moved vertically and horizontally as required.

On rotating the handle *e* two wheels of the sets of gearing G and G′ transmit motion to the spindle J, which by means of the pinion $c^2$ actuates one of the racks *c c′*, which causes the bar D′ to move forward, consequently the inclined plane D (the angle of which in relation to the bar D′ has been adjusted) presses against the roller

$l$ and effects the requisite traverse of the slide rest B and tool $b'$, which acts on the screw-blank $x$ secured between the centres of the machine as in an ordinary lathe. As the relative speeds of the shaft E and the rack $c$ are the same, it follows that if the height or angle of the inclined plane D be varied by means of the adjusting screw $o$, the traverse of the guide D′ being also increased or diminished, the spirals formed by the cutting tool will be at greater or less intervals, consequently the pitch of the screw thread will be varied.

The two sets of gearing G and G′ serve to change the relative speeds of the shaft E and the rack $c$ in order to cut screws of a given number of threads.

In order to cut screw threads in the reverse direction it is simply necessary to reverse the position of the bar D′, when the rack $c$ will be brought into gear with the pinion $c^2$ of the shaft J and the direction of rotation of the shaft E being also changed.

When cutting double or multiple-threaded screws it is necessary after the first thread has been cut to change the position of the pin $h$ in the plate or chuck H against which the dog $t$ presses in order to cut a second thread, the operation being repeated for each succeeding thread. In each case, of course, the inclined plane D with its guide D′ is brought back to its starting-point before commencing a fresh thread.

Figs. 1 and 2 of the woodcuts show the application of the adjustable inclined plane to a portable tool or screw stock, which may also be employed as a universal screw-cutting machine by fixing it in a vice or otherwise attaching it to a workbench.

Fig. 1 is a longitudinal vertical section of the portable tool, and fig. 2 is a transverse section showing the mode of actuating the guide of the inclined plane.

Fig. 1.

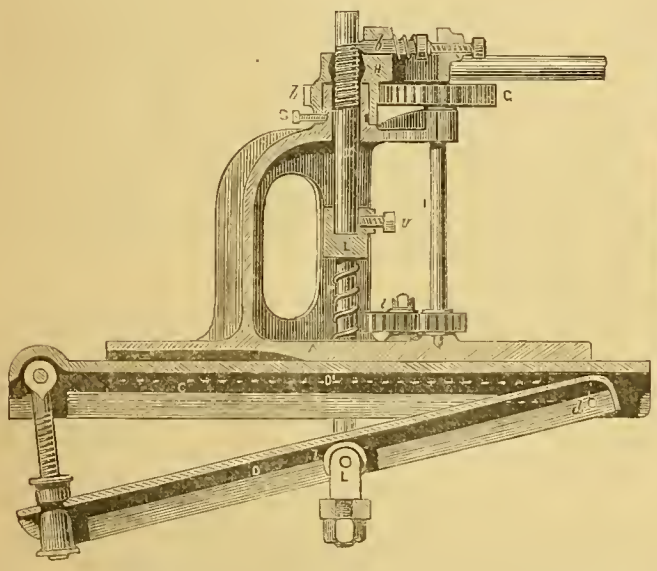
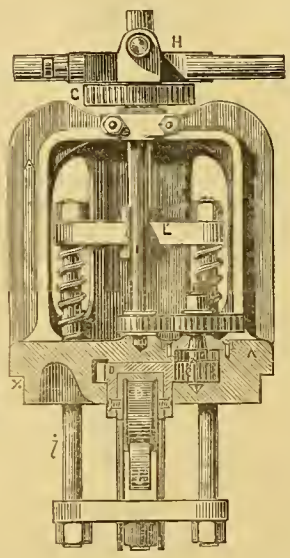


Fig. 2.



It will be observed that the same arrangement of inclined plane D as that described with reference to the plate engravings is employed in this description of tool, and that the same letters indicate corresponding parts in both arrangements.

The blank $x$ to be screwed is placed vertically in the centre of the cross piece L′, which is connected by the rods $l'$ to the roller carrier L disposed under the inclined plane D; the object of the springs $r$ is to draw the roller upwards in order to keep it in contact with the inclined plane, the motion of which causes the descent of the screw blank $x$, which is firmly secured in the cross piece L′ by the screw $v$.

The cutter $b$ is mounted on the body of the screw stock H so as to be capable of receding under the action of a helical spring. The screw stock is provided with dies which simply serve to centre the screw blank to be operated upon, and it has cast or forged upon it a pinion $h$ which gears with the wheel G keyed on to the upper end of the spindle I. This spindle carries a pinion $i$ which by the intervention of the wheel $j$, fixed on the spindle J, actuates the pinion $c^2$, gearing with either the rack $c^1$ or $c$ as the case may be of the guide D′ of the inclined plane.

It follows from this combination that on turning the screw stock by hand rotatory motion is imparted through the gearing above described to one of the racks in order to cause the inclined plane D to move forward; as the inclined plane advances the cross piece L′ descends and the cutter $b$ cuts the spirals to a greater or less pitch as may be required.

The screw stock turns round a socket cast on the frame A, which serves as an axis, and in order to prevent its displacement during the course of the operation a small screw $s$ is provided, which enters an annular groove formed around the axis as shown in fig. 1.

The methods of regulating the position of the inclined plane in relation to its guide D′ are similar to those employed in the screw-cutting machine first described.

The frame is reduced in width at its lower part so as to form shoulders X, which rest on the jaws of the vice, in which the whole machine may be placed.

M. de Résener proposes to apply the principle of the inclined plane to other descriptions of screw-cutting machines and to other combinations of tools suitable for cutting screws.

## ON INSTRUMENTS FOR INJECTING AND EJECTING FLUIDS AND LIQUIDS.

It is now nearly eleven years since engineers were presented with that effective arrangement of apparatus for raising and forcing fluids known as the Giffard Injector—the invention of a then obscure Parisian mechanician, whose ingenious and now proven to be most important instrument would most probably have long lain dormant but for British brains and capital having been drawn towards it, so that the injector was speedily brought into practical use and manufactured on a very large scale by a well-known firm of English engineers, Messrs. Sharp, Stewart, & Co. of Manchester.

In Great Britain it was several years before the mechanical principles of the injector were understood; and we may recall to memory the numerous and absurd theories which were at one time propounded in regard to its action. The difficulties now have altogether passed away, and some few engineers have begun to see much wider and various other fields of employment of the injector in many other forms than that which it has generally received hitherto.

Most probably, if we were to range over whole fields of mechanical development, we should find no other in modern times which would present to us a more truthful picture of the manner in which an important invention takes its rise, and, by revolving in the thought of certain men in successive generations, progresses onwards, and often retrogrades, prior to any practical advantage being matured from it.

Many engineers were truly amazed by the powers of this instrument when Giffard first made known its well-ascertained capabilities; but how little did we then know, and how little has any one yet attempted to make known, the history pertaining to it; nay, we might rather say how little at that time did we expect that such *a novelty* (?) had any history!

The latest application of the principles of the injector has been in employing them in specially arranged apparatus in substitution of the ordinary air-pump and condensers of steam-engines; but as we shall hereafter enter very fully into this application, we purpose to bring in our remarks thereon in their due order of sequence, after we have first of all analysed the steps by which instruments of the kind progressed up to the time of Giffard's arrangement.

Among the earliest attempts to use a jet of steam for impelling

another fluid (excepting some few proposals during the eighteenth century) was that made by William Nicholson in 1806 in his apparatus for producing blast, and at that time the well-known editor of the *Philosophical Journal*. After setting forth generally the manner in which he proposes to produce a rush of fluids by the action of a jet of steam escaping into a surrounding passage, as shown in the diagram fig. 1, where *a* is the steam jet, he is particular in describing the expanding throat of such instrument, but it appears that he did not conceive the form of throat expanding in a properly proportioned curve. Indeed, in the drawings which he has left us the throats are all shown in the form of straight-sided cones, whilst one of his applications consisted in applying the steam jet to the water-blowing engine described by Chaptal and other writers of note, in which it was made to impinge directly upon the water just as in the injector. Fig. 2 is a diagram of this apparatus, in which *a* is the steam jet and *b* the water chamber, out of which the water is pulled rapidly through the several openings *c*.

Fig. 1.

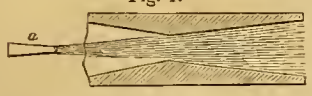
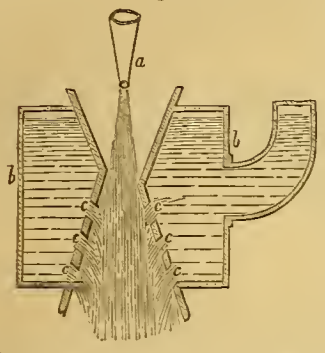


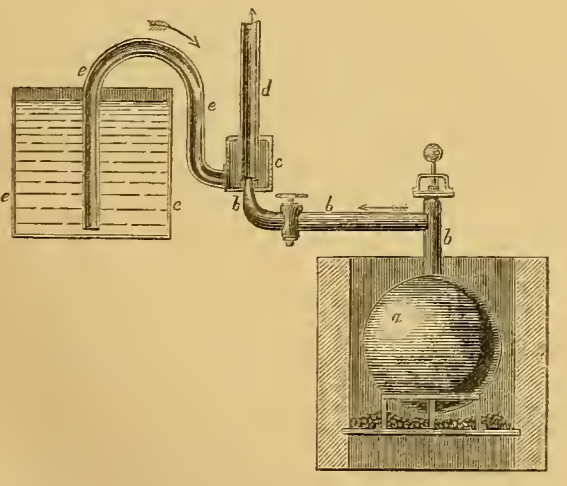

Fig. 2.




In 1818 the Marquis Mannoury d'Ectot developed a series of apparatus intended by him to be employed as motors.

He states: "In my experiments at the École des Ponts et Chaussées I had discovered that a jet of water passed through a trough is capable of charging itself with an additional quantity of water, so that the natural height to which the jet would flow without such increment becomes diminished in a constant ratio; and therefore the arithmetical product of the quantity of water per unit of time in the original jet by the height to which it would rise is exactly equal to the product of the sum of the initial jet and its addition into the reduced height to which the incremented jet would rise. It remained then for me to demonstrate that fluids in motion could with advantage put in motion other fluids of different densities; therefore a jet of air placed in the centre of a jet of water confirmed the truth of the above conclusions." The Marquis Mannoury d'Ectot also demonstrated, by aid of the apparatus shown at fig. 3, that steam escaping through

Fig. 3.



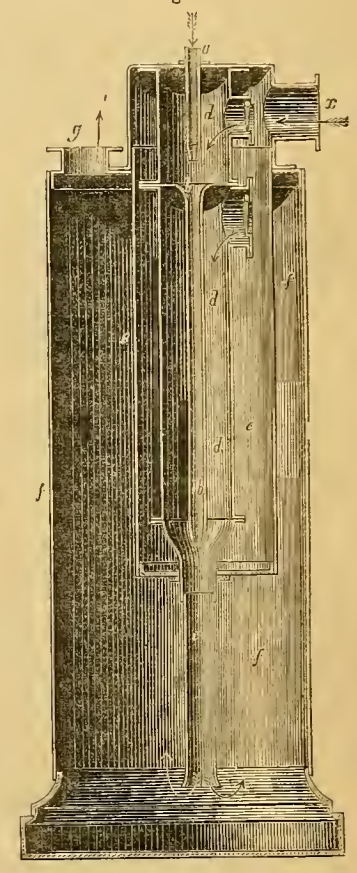

a narrow orifice was capable of communicating its energy to another fluid. This apparatus consists of a boiler *a* mounted with a pipe and conical jet *b*; this jet passes into a chamber *c*, and its extremity enters a short distance upwards into the vertical conduit *d*, so that by rushing up through this conduit it produces a partial exhaustion in the chamber *c* and pipe *e*, thus causing the water to flow into the chamber *c* from the cistern *e*, and from which it is ejected through the conduit *d*. Now, in this example it will be observed that the water is lifted from a depth below the jet and forced to a height above it.

In 1841 Pierre Pelletan obtained a patent "for propelling fluids and vessels." His apparatus also consisted in employing a steam jet for acting on the fluids, as in the apparatus above described.

In 1848 M. Bourdon, the well-known inventor and manufacturer of the pressure and vacuum gauges bearing his name, turned his attention to devising an apparatus which he denominated the *aspirateur de vapeur*.* This apparatus has for its object to attract or draw off the vapour from evaporating condensers or pans, and to transmit it into the cylinders of steam-engines.

Fig. 4 represents this apparatus, consisting of a tube *a*, which communicates with a generator (steam boiler), and is of small diameter relatively with the other parts of the apparatus; it terminates in a conical nozzle, which directs the vapour escaping from it into a second tube also terminating in a conical nozzle *b*, at its lower end. A cylindrical vessel *d* is closed in by a casing *e*, which communicates by a branch at its upper extremity with the condenser. The vessel *d* carries two extremely sensitive hinge valves towards its upper part, and these are so arranged as to act with facility with very low pressures of vapour. When these valves open, communication is established with the casing *e*, and therefore with the condenser or evaporating pan. It results, then, from this arrangement of apparatus that when the vapour passing from the generator escapes through the tube *a*, it forms a vacuum in the upper division of the vessel *d*; consequently the vapour which is produced in the evaporating pan is drawn off towards the *aspirateur* through the branch *x*, and passing into the casing *e* forces open the upper valve in the vessel *d*, into which it then escapes, and mixes with the vapour which arrives therein through the tube *a*, passing down through the second tube *b*; but, as it debouches into a third tube *e*, the escaping mixed vapours also form a vacuum in the lower chamber of the vessel *d*, so that any vapour which does not pass through the upper valve in the vessel *d* becomes drawn in through the lower valve. In this manner the entire vapours become admixed, and escape by the tube *c* into the vessel *f*, which encloses all the apparatus, and is provided at its upper end with a branch pipe *g*, through which the vapour is conducted to the valve chest of an engine.

Fig. 4.




The tension or elasticity of the mixed vapours is thus supposed to be increased beyond that due to the temperature and pressure of the vapour or steam coming from the generator, while at the same time the vapours are with facility and in an economical manner drawn off from the evaporating pans.

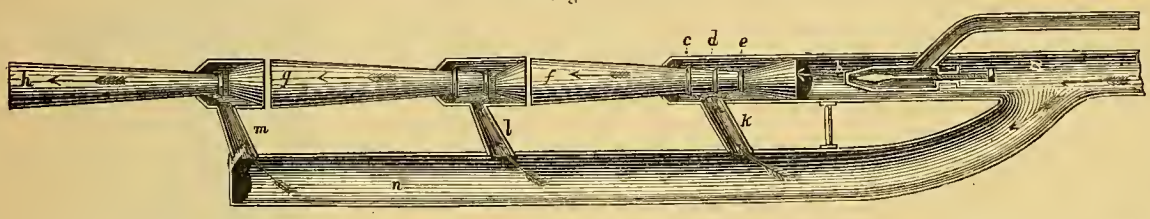
In 1855 Christophe François Delabarre patented a large fasciculus of contrivances to be used in propelling gases and in forcing fluids. His specification is in fact a treatise on the subject, in which he begins by setting forth the experience which had been gained by him and the late Professor Pelletan on the property which steam has of attracting or carrying along with it and propelling or driving air and other gases, and wherein he states: "The dynamics of liquids and fluids acting in such a manner being very difficult to investigate, we have ever since made new researches

* Literally, *vapour-attractor*.

and numerous experiments on this subject, in order to discover the best way of putting the above principles into practice." Delabarre sets forth very clearly to how full an extent he had grasped the subject; and he further remarks: "Although any gaseous fluid and any liquid whatever may be employed for producing attraction, air and steam are best fitted for that purpose. The form which these bodies take when they issue from orifices is very important to know, and I have ascertained that this shape is always conical, the cone never varying with the pressure."* We recommend a perusal of Delabarre's specification by those of our readers who desire to fully trace up the history of instruments for injecting or ejecting fluids by means of jets of steam or gas.

In 1857 M. Bourdon again produced a different form of apparatus constructed with tubes and divergent cones or throats. The apparatus which we now describe is that which he designated *l'aspirateur à actions successives*. Fig. 5 is a sectional elevation of this instrument; it consists of a tube *a*, which may be either cylindrical or conical, and in the centre of which is fixed a conical nozzle *b*, whose area of orifice is capable of being varied by aid of the central and curved spindle shown in the figure.

Fig 5.




At the termination of this first tube and in the same axis is placed a diverging or conical tube or throat *f*, having the annular openings *c d* and *e*, enclosed in one and the same envelope, which communicates with a side passage *n*, uniting all the exhausting tubes *k l m*. After the second tube *f*, or third and fourth *g* and *h*, respectively are placed.

This arrangement of tubes has for its object to utilise the force of a current produced by a jet escaping from a nozzle. If, then, at the end of the first tube the jet has sufficient velocity to attract more vapour or gas from the lateral conduit *n*, this attractive action will also take place in the second as well as the third and following tubes; in a word, the apparatus is composed of a number of divergent tubes so arranged that the velocity of the central current is gradually increased by successive aspirations or drawings into it of successive charges of the gas or vapour.

From what we have now put together a very fair picture may be found of what had been done in the way of using jets of fluids and liquids for producing motion in a fluid exterior to the jet previous to the year 1858, when Giffard conceived the employment of similar apparatus for feeding boilers. To Giffard the credit is due for having determined approximately the correct form of the throats of instruments of this class; that is, in making them expand in a curve so that the velocity of the injected jet of fluid may be reduced without shock. The important features of Giffard's instrument are described in what are almost his own words; thus, the lower extremity of the mouthpiece is gradually contracted inwards so as to unite or collect in one compact vein the liquid jet which issues into it in a more or less broken or scattered state, whilst the outer portion of the mouthpiece is expanded gradually, so as to cause the jet to lose successively and without shock to the liquid the speed which it has attained, so that it may arrive at the outer portion of the apparatus at a pressure at least equal to that of the boiler, without possessing any notable speed, and consequently without loss of *vis viva*.

In conclusion of this our first paper on this subject, it is worthy of remark that the mathematical principles of the *flow of liquids through tubes of gradually varying section* were investigated by Bernouilli, and he demonstrated that the sum of the heights, and the velocity to which a jet will flow, due to a given pressure, is constant in any section of a horizontal tube, so that $p'$ being the pressure, and $v'$ the velocity in a section $a$, $p''$ the pressure and $v''$ the velocity in a section $b$, $\pi$ being the density of the flowing liquid, thus,

$$\frac{p'}{\pi}+\frac{v'^2}{2g}=\frac{p''}{\pi}+\frac{v''^2}{2g}.$$

As the quantity of fluid which passes in a given time through the sections $a$ and $b$ is constant, the section $b$ for example being greater than $a$, the velocity of flow $v''$ is therefore less than $v'$, and it follows therefore that the pressure $p''$ is greater than the pressure $p'$ and which may be reduced to the limit

$$v''=o.$$

which is the value of

$$p''=p'+\frac{\pi v'^2}{2g}.$$

It follows equally from Carnot's formula that if a mass $m$ is moving with a velocity $u$ against another mass $m'$ with a velocity $u'$, their elasticity by supposition being *nil*, and in such manner that the two masses unite into a single compounded mass, they after uniting require a mean velocity $v'$, which is the result of the formula,

$$mu+m'u'=(m+m')v'.$$

Now the action of the injector is expressed by these two principles. Thus the steam from a boiler, which tends to flow into the atmosphere with a velocity depending on its pressure, and water which flows with a comparatively feeble velocity, form a mixture which assumes a velocity $v'$; this velocity diminishes in the ratio of expansion of the throat, but in order that the water may be forced into a boiler or other vessel against a pressure $p$, it must not be reduced to an extent less than that wherein the work or energy in the water is less than $p$; or, in other words, it must follow that

$$m\,v > p,$$

$m$ being the quantity of water per unit of time.

V. D.

*(To be continued.)*

* Our readers must bear in mind not to confuse this with that of a fluid jet escaping into the atmosphere, in which case the jet becomes broken into spray, at a distance from the nozzle or mouthpiece from which it escapes, which distance shortens with the smallness of diameter of the orifice, so that a large jet under a given pressure flows to a greater distance in a solid stream than a smaller jet will flow.

## SODA MANUFACTURE ON THE TYNE.

By R. Calvert Clapham, Esq., F.C.S.

According to the most recent printed returns (for 1867), the raw materials now used annually on the Tyne, in producing Soda and its allied manufactures, amount to 1,070,000 tons, and consist chiefly of Pyrites, Salt, Chalk, Timber, Coal, and Manganese, and are of the aggregate value of 830,925*l*. In return for this outlay there is produced:—

| | |
|---|---|
| Soda crystals | 86,000 tons. |
| Alkali | 74,000 „ |
| Bi-carb. soda | 11,000 „ |
| Sulphate of copper | 200 „ |
| Sulphate of soda (for sale) | 2,400 „ |
| Bleaching powder | 27,000 „ |
| Caustic soda | 3,720 „ |
| Epsom salts | 590 „ |
| Glauber's salts | 20 „ |
| Oil of vitriol (for sale) | 9,000 „ |
| Hypo-sulphite of soda | 400 „ |
| Muriatic acid (for sale) | 700 „ |
| Chloride of Manganese | 1,300 „ |
| | 216,330 tons. |

of the aggregate value of 1,929,825*l*.

The number of workmen employed in the soda works on the Tyne, is estimated to be 8,000; and the number of vessels which discharged cargoes of raw materials at soda works, in 1867, was 5,000. The floating and fixed capital employed in soda works on the Tyne is from 2,000,000*l*. to 2,500,000*l*.

In Lancashire, the production of chemicals is nearly the same as

on the Tyne; the raw materials amounting to about 869,600*l.*, and the manufactured articles to 1,883,779*l.*; thus giving the totals for the whole of England as under :—

| | |
|---|---|
| Raw materials | £1,700,525 |
| Manufactured ditto | 3,813,604 |
| Capital | 5,000,000 |

Such are the main facts as they now present themselves to us. It may be interesting to inquire into the history of so important a branch of English industry, especially in this locality; for, as far as can be ascertained, the first soda works in England was commenced on the river Tyne. Before taking into consideration the artificial production of Soda, we may glance for a moment at the time when alkalies were derived solely from the vegetable kingdom, and when bleaching was effected without the use of Chlorine.

The Glass Trade was established at an early date in this district. Mr. R. W. Swinburne informs me that the first window-glass works in England, was erected at the Ouseburn, by Admiral Sir Robert Mansel, in 1630; and that Mr. John Cookson put up glass works at South Shields shortly afterwards.

The Soap Trade was commenced by Lamb and Waldie, at Westgate, in 1770, and both branches of industry were supplied with alkali from Spanish Barilla, Russian Potashes, and Scotch Kelp—but chiefly from the latter.

The Scotch Kelp varied in strength from 1½ to 6 per cent., but did not average more than 3 per cent. of alkali; and the Barilla contained about 25 per cent. of alkali. The neutral salts were Sulphates and Chlorides of Potassium and Sodium.

From the first production of Kelp in Scotland, in 1730, to the end of the last century, its price gradually advanced from 2*l.* 5*s.* to 11*l.* per ton; and the price of Barilla at the same date was about 45*l.* per ton. These prices are equal to 180*l.* or 200*l.* for a ton of Soda Ash, which is at present worth 8*l.*

The only method employed, as late as a hundred years ago, in bleaching the British-made linens, and calicoes, &c., after boiling them in leys from Kelp, was to saturate them with sour milk, and expose them for long periods to the action of the air; but, on account of the uncertainty of the climate, it was necessary that the best cloths should be sent to Holland, and, after a summer's absence, they were returned for use in England.

Writing Paper was then only made from the whitest rags; and the expense of bleaching was found to be as great as that of obtaining alkalies. It was under these circumstances, and when the supply of high-priced and crude materials was found utterly inadequate to meet the increased demand for chemicals, that a *new* manufacture was commenced in this district.

It happened that a north-countryman (the late Mr. William Losh) was living in Paris at the time of the Revolution, and his attention, as a chemist, was particularly directed to the artificial production of Soda. France, being then at war with almost every other continental nation, all her external supplies of Potash, Soda, and Nitre, were cut off. Under these circumstances, in 1792, the Committee of Public Safety instituted an inquiry into the best method of manufacturing Soda from common Salt. Up to that time various methods had been proposed, both in England and France.

As far back as 1777, Malherbe had suggested to the French Government the decomposition of Sulphate of Soda, by means of Carbon, Tin-parings, and Iron; and, in 1781, Alexander Fordyce patented a plan in England for using Oxide of Iron.

The employment of the metals, or metallic oxides, was discovered in practice to present many difficulties, and the suggestions were not carried out. It was Le Blanc, Dizé, and Shea, joint associates, who suggested to the French Government the use of lime, as a means of separating the sulphur in decomposing Sulphate of Soda; and, it is scarcely necessary to add, that their method has been adopted in practice, both on the Continent and in England.

With a zeal characteristic of the times, a small manufactory was erected at the national expense, at Franciade, near Paris, and in the year 2, or 1794, it was fully at work. The operations did not, however, proceed satisfactorily. The quantity of Soda turned out was smaller than expected, and many difficulties presented themselves. Le Blanc and his fellow associates were discarded by their Government, and became so embarrassed and discouraged, that they appealed for aid to the English Government, and received some pecuniary assistance. Le Blanc died in poverty in a French hospital; but, it is satisfactory to know, that statues were erected to his memory.

It was not till twenty-eight years after the time I have named that Le Blanc's process was adopted in England.

About 1793 or 1794, Mr. Losh and the Earl of Dundonald commenced a series of experiments in the manufacture of Soda, at Bell's Close, near Scotswood, which resulted in the Earl taking out a patent, in 1795, for "Treating Neutral Salts to obtain Alkalies." Soda was made at Bell's Close during these years, but to what extent, or by what process, there is no record.

The works conducted at Bell's Close were removed in 1797 to Walker, near Newcastle; a lease having been signed on the 29th September for twenty-one years—the object being to obtain a more eligible site, and to make use of a salt spring recently discovered there. A coal pit, called the King Pit, had been sunk in 1788 by the late Mr. Barnes, and an engine erected by the well-known engineers, Bolton and Watt, in the same year to work the coal. This engine was put up on the old principle of the "sun and planet motion," and is still at work.

In the shaft of this pit, the spring was discovered, and on the 24th June, 1798, a lease was signed with the Corporation of Newcastle, for its exclusive use, and an agreement entered into with the owners of Walker Colliery to pump the brine. A 4-inch lead pipe was put down on the outside of the metal tubbing of the pit to the salt spring, and the engine did the double work of drawing the coal and pumping the brine.

The Salt Spring was analysed by a Mr. G. Woods, and gave as under :—

*Contents in* 1,000 *grains of Brine.*

| | |
|---|---|
| Chloride of sodium | 32 grains |
| Chloride of calcium | 10 „ |
| Chloride of magnesium, Carbonate of lime, Carbonate of iron, Silica | 1 „ |
| | 43 grains |

Its strength was 7½° upon Twaddell's Hydrometer, and it was conveyed in wood spouts from the pumps to the evaporating pan, near the pit shaft.

The price of small coals used in evaporation, was 5*s.* 6*d.* per chaldron, and the total cost of making the salt was as under :—

| | *s.* | *d.* | |
|---|---|---|---|
| Coals and cartage | 21 | 9 | per ton |
| Wages | 6 | 1 | „ |
| Pumping | 6 | 0 | „ |
| Total | 33 | 10 | „ |

(*To be continued.*)

## ON METHODS AND TOOLS USED FOR FIXING TUBES.

(*Continued from page* 8.)

When reviewing certain methods of fixing tubes in our former paper, we confined our remarks more especially to boiler tubes. On this occasion we propose to consider what has been done to effect the same object in surface condensers.

The methods which have been at different times employed for fixing condenser tubes may be divided into three general heads :—

A.—In which the packing used is metallic.

B.—By means of fibrous packing.

C.—By means of elastic media such as india-rubber.

Method A was proposed and first used by James Watt for fixing the tubes of his surface condensers, which he at an early date used in preference to the injection condenser. We are not informed accurately (so far as we have been able to ascertain) as to the precise details of the method by which they were fixed, but as their upper and lower ends were secured in cast-iron boxes, we imagine that they must have been expanded by drifting. Similar condensers, so far as we can learn, were constructed on the Clyde by Mr. David Napier about 1820-21, and about the same period Brunel patented another form of condenser.

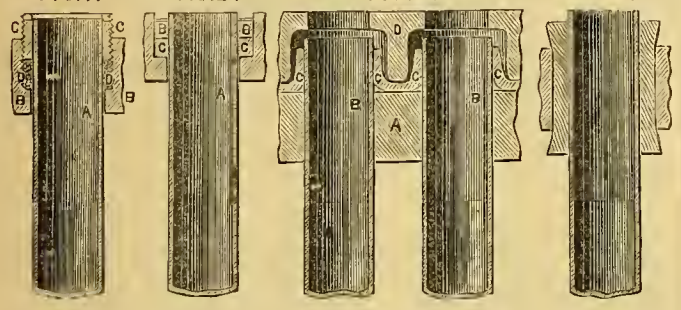
Very little of importance was, however, achieved with the sur-

face condenser until 1831, when Samuel Hall turned his attention to the subject, and eventually produced such excellent results.

His mode of fixing is shown at fig. 1, which is a longitudinal section of a tube A, fixed in the condenser tube plate B. The hole in the tube-plate B is recessed to a considerable depth, the recess forming an annular space surrounding the tube when in its place, and it is tapped so as to receive the short screwed ferule C, which being screwed down, compresses the ring of hemp D into the lower part of the recess. By this means the tube is not only very effectually held in the plate, but at the same time it is allowed to expand and contract freely without straining either the plate or itself, whilst, by merely withdrawing the ferules at either end of the tube and picking out the hemp packing, the tube is left free for removal. We must remember that this arrangement of Hall's was the first which was found practically successful. There is no record of a surface condenser having been successfully employed in a sea-going steamer at any previous date.

As we are not at present discussing the merits and construction of condensers themselves, but one particular detail only, next in order we find Spencer's method, shown at fig. 2. This consists in recessing the tube plates around each tube A to the depth of 0·125 to 0·187 of an inch in width, and compressing into them two or more (but usually two) india-rubber rings B C, which are put in sufficiently tight to prevent leakage when the pressure is on the outside of the plate. Then follows Sewell's ; it is shown at fig. 3. This plan of fixing condenser tubes is perhaps the most complicated of any introduced. The tube B projects some distance

FIG. 1. FIG. 2. FIG. 3. FIG. 4.



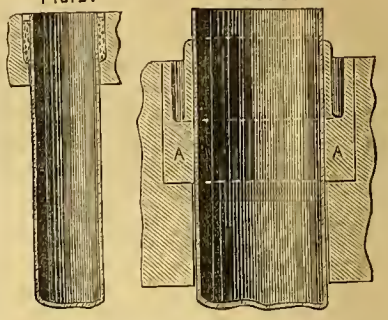
beyond the tube plate A ; over these projecting portions a sheet of india-rubber, formed so as to fit over the whole of the tubes, is placed. This sheet is necessarily made in one entire piece, of the same size as the tube plates, and in it holes are formed to correspond in pitch with that of the tubes ; but the holes themselves are slightly less in diameter than the tubes, so that on being placed over them the india-rubber turns up in a cup-like form round the exposed ends as shown. Over the india-rubber sheet is an outer plate D perforated to correspond with the tubes ; it is recessed as shown, so as to pass over the tubes and surround the india-rubber cups, at the same time leaving room for the tubes to expand and contract freely when the plates are screwed together. The diameter of the holes in the outer or covering plate is nearly the same as the interior calibre of the tubes themselves, and it serves two purposes, namely, of keeping the india-rubber sheet close against and on the ends of the tubes, at the same time preventing the tubes from working out of the plates. This method, although the most expensive, has, we believe, been pretty largely adopted of late years, but we know that some engineers do not think favourably of it.

Allen's method is shown at fig. 4 ; it consists merely in inserting a wooden ferule A into an annular space in the tube plate which surrounds the tube ; this on being driven in becomes compressed, thereby filling the hole, and at the same time firmly holding upon the tube, but before being put in, the ferules are first squeezed in a compressing machine.

Howden's method is shown at fig. 5. In this case the hole for receiving the tube is reduced to a depth equal to about three-fourths of the thickness of the tube plate, and into it a short length of plaited cord is compressed, the cord being very easily and quickly inserted by means of a tool revolved in the recess by a hand-brace ; this system is perhaps the cheapest and simplest yet devised, and is, we understand, coming into use on board several steamers.

The last, and, so far as we can learn, a very effectual method of fixing condenser tubes is that introduced within the last few months by Marshall of Leith ; it is shown at fig. 6. In this example, the recess surrounding the tube is filled with an india-rubber ring A, which ring has a deep annular space formed in it, into which the water passes, having the effect of forcing the outer lip of the ring against the tube plate, and the inner lip against the tube, thereby constituting an effective joint on both sides. Marshall's plan is being already introduced on the Clyde as well as at Leith, and the North British Rubber Company have commenced the manufacture of the rings.

FIG. 5. FIG. 6.



We have now brought together all the more important modes of fixing surface condenser tubes, and as we shall on a future occasion probably refer at length to surface condensers themselves, we reserve further remarks on the subject at present.—V.D.

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## RECENT PATENTS.

### MANUFACTURE OF CHLORINE.

HENRY DEACON, *Appleton, Lancaster—Patent dated April* 29, 1868.

THESE improvements consist in the continuous production of chlorine by passing a current of hydrochloric acid gas and atmospheric air over a mixture of oxide of copper and oxide of manganese, or of other metallic compounds as hereafter referred to, and which produce similar effects. The materials employed should be heated to such a temperature that the hydrochloric acid gas may be decomposed, and its chlorine liberated. The decomposing power of the metallic compounds remains permanently active, and the process is therefore a continuous one.

In this process oxygen is the element required to unite with the hydrogen of the hydrochloric acid, and to set free the chlorine ; any available supply of oxygen may therefore be employed, but atmospheric air is the cheapest source.

In carrying out this process one at least of the compounds employed must be of such a character that it will have the power of uniting with oxygen either at the ordinary temperature or when heated ; and when it is afterwards treated with hydrochloric acid and heated either alone or in the presence of oxygen, it must possess the property of decomposing such acid and of ultimately yielding chlorine as one of the results of the decomposition. By applying this test to the metallic compound employed, the suitability of the mixture will be practically ascertained without difficulty.

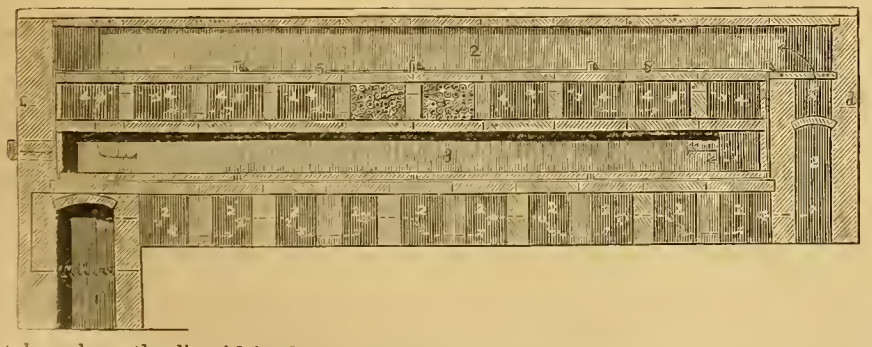
The hydrochloric acid gas and air, which is by preference previously heated, are passed over the heated metallic compounds, which absorb more or less of the hydrochloric acid gas and become saturated therewith, the saturation depending in part upon the temperature employed; and then, so long as the temperature remains constant, no further change is noticeable in the compounds, but the hydrochloric acid gas and the oxygen of the air react on each other in the presence of these compounds; and a continuous stream of hydrochloric acid and air entering the apparatus employed results in the issue of a continuous stream of chlorine and of the vapour of water, mixed, of course, with nitrogen from the air, unused oxygen, and hydrochloric acid.

There are several compounds which may be employed in carrying ont this invention, of which salts of manganese, lead and copper, are usually the most available, either alone or in combination, as may be readily ascertained by applying the test above referred to. The patentee prefers the compounds of copper because of the high temperature necessary when using the compounds of manganese and lead, except when the compounds of manganese are employed as a diluent, in order to prevent the fusing and caking of other more fusible compounds. Of the compounds of copper he prefers the sulphate, which may be employed as follows :—Common clay or fire-clay bricks or pipes are saturated with a strong solution of sulphate of copper, and placed in retorts or flues heated externally, and through which is made to pass, by means of pressure or dranght, the heated mixture of hydrochloric acid gas and atmospheric air, by which means and arrangement large surfaces of the compounds of copper are exposed to the action of the heated gases. To obtain a successful result attention must be paid to the temperature of the gases, which will vary according to the materials employed, say from about 400F. to 800F. or 850F.; if the temperature be raised to too high a point it will be found that certain compounds of copper are volatilised, whilst on the other hand, if the temperature is allowed to fall too low, the decomposition becomes less active, and ultimately the hydrochloric acid gas is absorbed, until the compounds become saturated therewith and decomposition ceases. The apparatus is also slow in recovering its activity at the working temperature, unless it be temporarily raised above it. One advantage arising from the employment of compounds of copper is the comparatively low temperature at which they act; but for practical purposes they require to be mixed with some other body or compounds to prevent their fusing together. Burnt clay will be found to be efficient for this purpose.

The accompanying figures illustrate one form of furnace suitable for the purpose. This furnace may either be composed entirely of brickwork, or it may consist of a cast-iron casing or chamber filled with and set in brickwork. The latter, which is the one illustrated, is more costly in erection and repairs, but prevents more effectually any escape of the gases or their dilution with the products of combustion from the smoke flues.

Fig. 1. is a longitudinal vertical section of the chlorine furnace

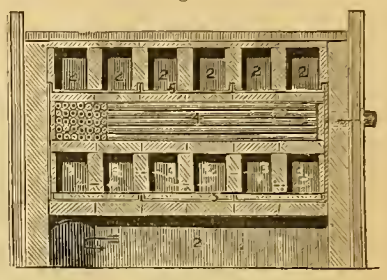
Fig. 1.



taken along the line *i k* in fig. 3. Fig. 2 is a transverse vertical section taken near the backward end of fig. 1. Fig. 3 is a horizontal section through the gas-decomposing flue along the line *c d*, fig. 1.

In these figures, 1 is the fireplace or furnace proper, and 2, 2 are the smoke flues, which are arranged in zigzag fashion beneath and above the gas-heating and decomposing flues. 3 is the gas-heating flue constructed in a zigzag form, the gas entering by an inlet pipe, and after traversing the entire length of flue passes into the decomposing flues 4; these flues are filled with drain-pipes soaked in a solution of sulphate of copper or other decomposing material. 7 is the gas outlet pipe leading from the decomposing flue to a condenser. 5 is a cast-iron chamber or casing, built inside the brickwork, and enclosing the gas-heating and decomposing flues 3 and 4, whereby an escape or loss of gas through leakage is entirely prevented; the casing 5 may be dispensed with, however, if desired.

Fig. 2.



The patentee also combines a chlorine furnace as described with a close "salt cake" or sulphate of soda furnace condenser and bleaching powder chamber. In this arrangement there is a closed "salt cake" pot or furnace and salt cake oven or roaster, the chlorine furnace being of similar construction to that described, the supply of hydrochloric acid gas being conveyed from the salt cake furnace by a pipe arranged for that purpose. The cooling pipes lead to the bottom of the condensing tower, and from the top of this tower a pipe leads into a bleaching powder chamber, which communicates by a short pipe with the chimney. A furnace of about twenty-six feet in length will produce sufficient chlorine to make about 3 tons of bleaching powder per 24 hours, but with extended experience this quantity will be materially increased.

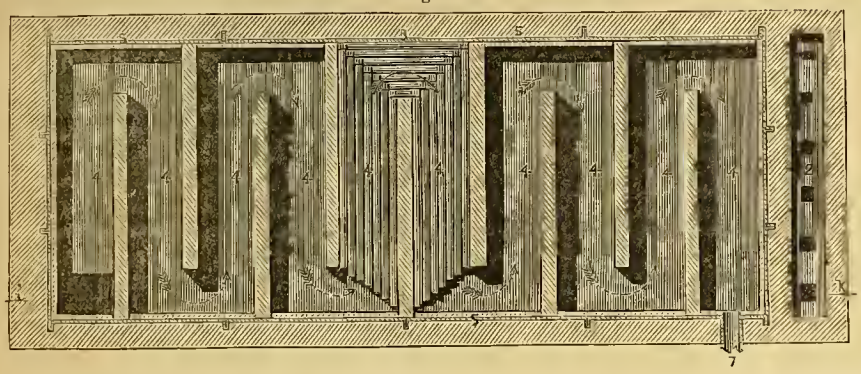
This arrangement gives a current of chlorine varying in quantity according to the evolution of hydrochloric acid gas from the "salt cake" furnace, which varies at each charge, being strong at the commencement and feeble at the end. Where a uniform current of chlorine is required, several "salt cake" furnaces may be arranged to one chlorine furnace and charged in rotation, one furnace charge working off as another is beginning and so on; or where a smaller but regular current of chlorine is required, the patentee prefers to use an aqueous solution of hydrochloric acid (as strong as convenient) as the source of hydrochloric acid gas. The patentee evaporates this aqueous solution in any convenient manner, running into the evaporating apparatus a constant stream of the aqueous acid, to maintain a constant stream of acid vapour. This is mixed with the necessary quantity of air and then passed through the chlorine furnace. When using aqueous hydrochloric acid more vapour of water in proportion to the chlorine passes through the apparatus, which necessitates provisions in the size and proportions of the various parts of the apparatus.

The aqueous hydrochloric acid as obtained from the ordinary "salt cake" process is fit for use in this way, and by its use the two processes of "salt cake" and chlorine-making can be separately and simultaneously conducted.

The arrangement given has the advantages of compactness, and keeps the intense heat of the fire from the compounds of copper; but the apparatus may be varied to a great extent, and in particular the primary heating of the gases may be effected in one apparatus and the decomposition in another; and it must be borne in mind that the decomposition itself is attended with evolution of heat, and therefore with a properly regulated supply of heated hydrochloric acid gas and air, and suitably protected decomposing apparatus, the latter will require but little or no external application of heat, but the working temperature can be maintained by due attention to the temperature of the current of gases passing into the decomposing apparatus. Various methods by which the waste heat of the salt-cake furnaces may be employed for heating these gases will suggest themselves to the practical operator. Hydrochloric acid gas passed through the apparatus must be mixed

with so much air as will give rather more than one equivalent of oxygen for every two equivalents of hydrogen contained in the hydrochloric acid gas. It is not necessary to dry the air previously, but its carbonic acid may be previously removed, if desired, by the use of lime or of an alkaline solution. The gases issuing from the furnace consist of chlorine, of the nitrogen of the air, of any surplus or uncombined oxygen, the vapour of water undecomposed,

Fig. 3.



hydrochloric acid gas, and any other gases either present in the air or originally mixed with the hydrochloric acid gas, or which may have leaked into the apparatus ; in other words, the chlorine will be largely diluted, and probably mixed with more or less carbonic acid and other gases. The hydrochloric acid gas and vapour of water may be removed from the mixture by condensation and cooling alone, and the subsequent use of a scrubber or of a column of dry coke to remove water mechanically carried with the current is usually sufficient ; otherwise, the condensation can be completed by the use of a dilute solution of hydrochloric acid, which absorbs mere traces of chlorine, but usually enough hydrochloric acid exists in the gases to condense in the water and expel the chlorine therefrom, and then water alone is necessary. The chlorine present is left available for all purposes not interfered with by its dilution with the gases before named ; as, for example, for the manufacture of bleaching powder, especially when not required of the highest strengths, and also for the manufacture of other products, such as chlorate of potash.

## COLOURING MATTER FOR DYEING.

John Henry Johnson, 47 *Lincoln's Inn Fields, a communication from* Alexander Clavel, *Basle, Switzerland.—Patent dated July* 22, 1868.

The object of this invention is the production of a red colouring matter suitable for dyeing, obtained from naphthaline. This product may be obtained by acting upon naphthaline by means of nitric acid, and after the separation of the free acid from the nitro-naphthaline the product is subjected to the reducing action of zinc or iron or other reducing agent in conjunction with an acid, by preference acetic acid. The result of this reducing process is collected and placed in a retort, and submitted to a distillatory process. On the application of the necessary degree of heat, naphthylamine will first pass over, and subsequently, at a higher temperature, the desired product is obtained, which may be collected in a separate receiver. The product so obtained is then to be acted upon at a temperature of about 120 centigrade with acetic acid and with nitrite of soda, and to this mixture naphthylamine is added and allowed to remain until the desired colour is produced. The crude materials or result are then subjected to the action of water, and then to the action of hot water containing an acid, by preference acetic acid ; the colouring matter is obtained in solution, from which it may be separated, either by means of common salt or otherwise, as is well understood by manufacturers of aniline colours.

The colouring matter thus obtained may be dissolved in alcohol or other solvent, and employed for the purposes of dyeing and printing. In carrying out this invention, it will be found that the proportions in which the several substances may be employed may be varied, but that good results will be obtained by employing equal parts of naphthylamine, acetic acid, and nitrite of soda.

## PREPARATION OF ANÆSTHETICS.

Astley Paston Price, *Lincoln's Inn Fields,* and James Alfred Wankyn, *London Institution, Finsbury Circus.—Patent dated* 17*th April,* 1868.

Hitherto protoxide of nitrogen (laughing gas), when intended for anæsthetical purposes, has been prepared and stored in the ordinary gaseous form, which has necessitated either the immediate preparation of the gas in the vicinity where it had to be administered, or the conveyance of the same in bulky gas-holders or in other inconvenient receptacles.

The patentees' invention relates to the preparation of the protoxide of nitrogen in such a form and combination that it may be more easy of transport and of storage, and also of being more easily purified as well as convenient for use when required ; and consists :—1st. In effecting the solution of the protoxide of nitrogen under pressure in solvents thereof (such, for example, as alcohol) ; such solvents being contained in vessels capable of being closed, and also of withstanding the required degree of pressure for effecting such preparation ; and—2nd. In effecting the solution of the protoxide of nitrogen by means of pressure in such anæsthetical agents as may be solvents of the same, and which may be useful medicinally (such, for instance, as ether or chloroform), or mixtures of the same.

In carrying out the first part of this invention the protoxide of nitrogen is prepared in the usual manner, viz. by heating nitrate of ammonia in a retort, and collecting the gases evolved. The protoxide of nitrogen gas, being collected in a gasometer, is by means of a pump forced into one or more of the solvents before referred to ; such solvents being contained in vessels of sufficient strength to resist the degree of pressure requisite for effecting the desired solution. In practice a pressure of about twenty atmospheres will be found sufficient for such purpose. When it is desired to obtain the protoxide of nitrogen of greater purity, the patentees employ a solution of the protoxide of nitrogen in any of the solvents before mentioned, but by preference alcohol, on account of its comparatively low volatility and cheapness. The gas is allowed to escape from such solution by diminution of pressure, and the gas thus liberated is collected and again forced into one of the before-mentioned solvents contained in a suitable receiver or container, so that a solution of highly purified protoxide of nitrogen gas may be obtained, or the protoxide of nitrogen gas thus purified and liberated may be specially employed for anæsthetical purposes.

The invention relates also to the employment and use of solutions of protoxide of nitrogen produced under pressure for anæsthetical purposes. When such solutions of protoxide of nitrogen which have been effected and which exist under pressure are to be employed for anæsthetical purposes, the reservoirs or vessels containing the same are furnished with suitable taps in connection with inhaling apparatus.

## FEEDING GAS RETORTS.

James Dunbar, *of Camberwell, and* Richard Nicholson, *of Dulwich.—Patent dated 6th April,* 1868.

This invention relates to the construction, arrangement, and combination of machinery or apparatus for feeding or introducing coal into gas retorts or ovens, and for withdrawing or removing the same after distillation.

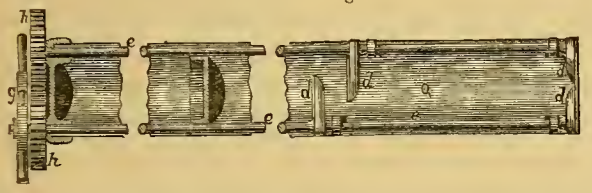
Secondly, to the construction and arrangement of the doors and door fittings of gas retorts, whereby existing retorts are better adapted for being supplied with coal or other gas-producing material by this combined feeding and withdrawing apparatus.

Thirdly, to an arrangement of the mouths of gas retorts whereby any one or more of a bench or group of retorts may be opened for cleaning or repairs without stopping the working of the rest, or causing loss or waste of gas therefrom.

The retort-house is fitted with two parallel over-head rails, which extend longitudinally and parallel to the range of retort mouths.

These rails support a traveller, which is provided with wheels, running along the longitudinal rails; other wheels are mounted on a carriage or cradle, and run transversely to the rails along the traveller. It will thns be seen that the cradle may be moved horizontally towards or from the mouths of the retorts, and may be brought opposite to any retort in the series. The traveller carries a grooved pulley or chain wheel, over which an endless rope or chain is passed for the purpose of rotating the same. On the spindle of this chain wheel or pulley there is keyed a spur pinion, which gears with a spur wheel, fast on the axis of one of the running wheels of the traveller, thereby imparting motion to it. The movement of the cradle along the rails of the traveller is effected by means of a winch handle. On rotating this handle motion is imparted to an endless chain or band, which passes round a pulley on the axis of the handle and over a larger pulley on the axle of one of the running wheels of the cradle, and consequently transmits a travelling motion thereto in either direction along the rails of the traveller. From the cradle or carriage are snspended wrought-iron frames, which snpport a combined scoop and rake. This scoop and rake is shown in plan at fig. 1, and in transverse section in various positions and in different forms of retorts at figs. 2, 3, 4, and 5. The outer end of the scoop, or that which is farthest from the retorts, is made

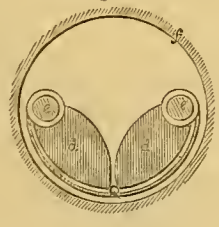
Fig. 1.



cylindrical, and this cylindrical portion forms the journal for the rotation of the scoop on its longitudinal axis. Radial lever arms are provided with bearings at their lower ends for embracing and supporting the cylindrical portion of the scoop. These arms are keyed on to a rocking shaft carried in bearings in the lower end of the snspended frames. The said rocking shaft carries a worm-wheel into which gears a worm on a shaft actnated by a hand wheel. The attendant in charge of the machine stands on a travelling platform, and by manœuvring the endless chain, or the winch handle, or hand wheel, as may be required, he produces all the movements requisite for introducing and withdrawing the scoop into and from the retort, and transporting it either in a horizontal or a vertical direction from one retort to another. On rotating the endless screw the rocking shaft rotates partially, by which means the radial lever arms will be brought to different positions, thus raising the scoop to the height of any one of the retorts in the

Fig. 2.

Fig. 3.



"bench." In order to maintain the upper surface of the scoop perfectly horizontal during this movement, the patentees employ any simple form of parallel motion; and they find that the desired result may be readily obtained by the aid of an endless chain passing over two equal sized chain-pulleys, the one being stationary and keyed or secured to the bearing, and the other fitted loosely upon the cylindrical part of the "scoop," but coupled therewith by the intervention of the well-known arrangement of detent and ratchet wheel. The object of the detent and ratchet arrangement is to enable the scoop to be reversed or turned over in its bearings for the purpose of discharging the coal into the retort (without interference from the chain wheel) after it has been introduced into such retort; whilst the detent serves to couple the chain wheel with the scoop when imparting the necessary parallel motion to the scoop for keeping its open side upwards or horizontal.

With the feeding scoop in most cases is combined one or more moveable blades or series of moveable blades, rakes, or hoes *d* shown in figs. 1 to 5. These hoes are intended to answer the purpose of the discharging rakes or appliances heretofore employed for withdrawing the charges from gas-retorts; and by combining snch hoes with the feeding scoop the patentees are enabled to perform by the one combined apparatns the two operations of feeding the retorts and withdrawing the charge, which operations have heretofore always been performed by the aid of separate and distinct instruments or appliances. Two or more of these hoes *d* are keyed on to

Fig. 4.

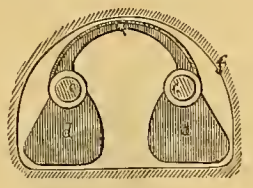
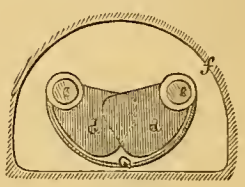


Fig. 5.



two parallel rocking shafts *e*, disposed longitudinally in bearings fitted inside the scoop. Or, if preferred, one rocking shaft *e* and series of hoes *d* may be combined with the scoop. In the former arrangement the hoes *d* may be rather smaller than in the latter case, as will be seen on referring to the figures. These hoes may be of various forms, according to the shape of the retort as shown in the transverse sectional views; and when not in action the hoes lie transversely across the scoop, being enclosed within the hollow or trough thereof, as shown in figs. 3, 4, and 5, which illustrate the position of the scoop and its combined hoes *d* when filled with coal for feeding the retort *f*. Before this operation, however, it is necessary to withdraw the coke or residnal products of the destructive distillation; for which purpose the combined scoop is introduced in an inverted position into the retort, the hoes *d* being well within the hollow of the scoop, so as to pass freely over the surface of the coke until the scoop has entered a sufficient distance therein. In this position the rocking shaft *e*, or the pair of rocking shafts as the case may be, are partially rotated in their bearings by the action of the hand wheel *g* and gearing *h* fast on the outer ends of the rocking shafts when two are used; thereby causing each hoe *d* to describe an arc of a circle in a downward direction so as to cut transversely across the mass of caked fuel or coke in the retort from side to side at each point where a hoe or pair of hoes *d* occur, the hoes then assnming the position shown in figs. 2 and 4. In this condition the scoop is withdrawn from the retort by running back the cradle, and the entire contents of the retort will be drawn ont with it at one single stroke or traverse, leaving the retort ready for a fresh charge. The hand wheel *g* is now turned in the reverse direction, which has the effect of turning the blades or hoes inside the scoop again, and by continuing to act upon the same hand wheel the rotation of the scoop in its bearings will be accomplished. If desired, bevel-wheel or other suitable gearing may be employed for turning the scoop, but in single-scoop machines it is convenient to apply hand power direct. The patentees do not confine themselves to any particular mode of reversing the scoop. Figs. 2 and 3 show the combined scoop and hoes adapted to a circnlar retort, and figs. 4 and 5 illustrate somewhat similar scoops and hoes adapted to D retorts. In some cases it is proposed to use a pair of combined scoops and hoes or rakes for supplying one retort, whereby a more even spreading of the coal over the bottoms of wide retorts will be effected. The patentees also propose to pnsh ont the coke from the retort by using the end of the entering scoop as a ram, the coke being expelled through one end of the retorts whilst the coal is introduced at the other end.

The scoops are supplied with coal either by manual labour or from a travelling tender, which consists of a coal box or bunker suspended from a frame mounted on running wheels, which traverse longitudinal rails in company with a traveller, so as to be always in readiness for filling the scoops. The scoop to be filled from the tender is bronght into a position so that the coals may be shovelled by an attendant inside the tender through a spout directly into the scoop. The tender may be kept supplied either by self-acting means, as for example by an elevator, or by manual labour: the elevator, if employed, may be driven by any convenient prime

mover used for manœuvring or actuating the rest of the apparatus.

In order that the retorts may be charged and discharged with facility by means of the aforesaid apparatus, it is found expedient to provide them with hinged doors or covers in substitution for the ordinary loose covers; each retort mouth having its own door. For this purpose the patentees propose to apply to existing retorts, whether of the circular or D section, a cast-iron frame A shown in the sectional elevation, fig. 6. This frame may be secured by bolts or otherwise to the ordinary retort mouth, and carries a hinge to which the door C is hung. On the inner face of the door there is provided a projecting rim *a*, which fits into a corresponding

Fig. 6.

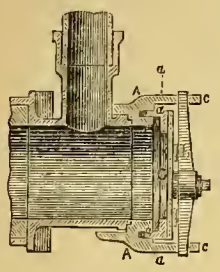
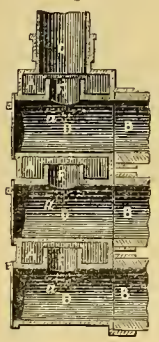


Fig. 7.



groove in the frame A, such groove being filled with any good lute before the door is closed. By this means a perfectly gas-tight joint is readily obtained. The door is tightened up by a central screw in the swivel cross bar *b*, which fits into lugs *c* at the top and bottom of the frame.

Fig. 7 is a sectional elevation of a mode of combining two, three, or more retorts with one chamber and ascension pipe, whilst at the same time facility is afforded for gaining access to each retort separately without interfering with the working of the rest of the retorts in the said chamber. A is the chamber in connection with which three retorts B are shown, and one ascension pipe C. Three passages D are made through the chamber corresponding to the several retorts and forming continuations thereof. Each of these passages or extensions of the retorts is closed by a small hinged door of its own, by which means access to any one of the retorts may be obtained without interfering with the others. The gas passes from the retorts into the chamber A through the orifices F in the passages D; the said orifices being each provided with a screw valve or cover *a*, by the closing of which that particular retort is shut off from the chamber in order to prevent any escape of gas from the chamber, which continues to be supplied through the orifices F in connection with the other retorts. Thus any one of the retorts may be opened for the withdrawal of its charge, or for scaling or other purpose, without stopping the working of the rest, and without any escape or loss of gas.

## MANUFACTURE OF MANURE.

BENJAMIN EDWARD REINA NEWLANDS, *Charlton, Kent.—Patent dated October* 3, 1868.

THESE improvements relate—firstly, to the manufacture of manure from organic matters containing nitrogen; and secondly, to the production of salts of ammonia. In carrying out the first part of this invention, the patentee takes any organic matter containing nitrogen; such, for example, as dried blood, woollen waste, or leather clippings, which are treated with vitriol or sulphuric acid at a temperature of about 300 to 400 Fahr.; the mixture is allowed to digest until the organic matter has been thoroughly acted upon and converted into a black mass. To the product thus obtained, native carbonate of magnesia, or magnesian limestone by preference, in a state of division is added, so as to neutralise the excess of acid, and thus obtain a dry substance (containing a high percentage of nitrogen and sulphate of magnesia); which is used either by itself or mixed with phosphate of lime in the course of its manufacture into superphosphate, or afterwards so as to form a manure. In some cases it is preferred to separate or wash out the excess of acid from the black mass, and to employ the resulting carbonised material (without the addition of carbonate of magnesia or magnesian limestone) as a manure. The acid thus separated may be again employed for similar or other purposes. Under the second head of this invention the patentee utilises the nitrogen contained in the impure sulpho-cyanide of ammonium, obtained by washing or triturating oxide of iron (generally known as spent oxide of iron) which has been used for purifying gas. The solution thus obtained is treated in the following manner:—The requisite amount of lime is added to liberate the ammonia contained in the solution, and the ammonia it contains is distilled off as collected in sulphuric acid. The sulpho-cyanide of calcium remaining in the distilling apparatus, if dry, is mixed with slaked lime, but if wet, dry lime is used, and the mixture is submitted to dry distillation, and the ammonia evolved is collected in sulphuric acid.

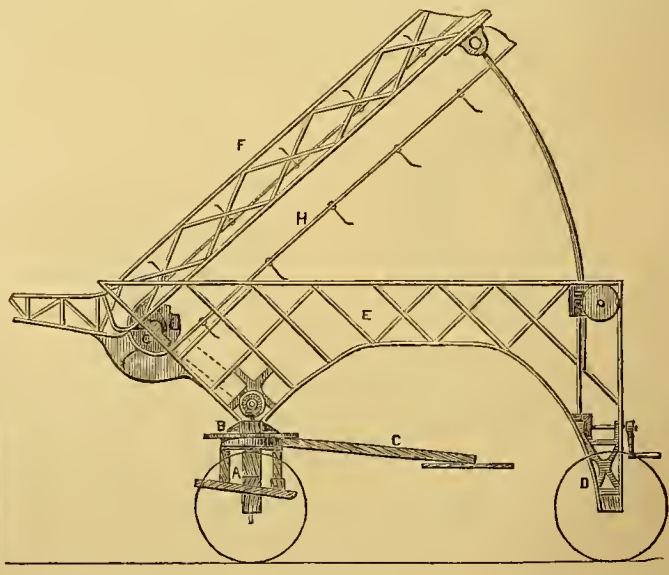
Another part of the invention relates to the converting of the nitrogen contained in sulpho-cyanide of calcium resulting from the purification of coal gas into ammonia by dry distillation, either with slaked or dry lime as the case may be, and collecting the ammonia in the usual way. In any case where ammonia is to be evolved, retorts or stills are to be employed, and the ammonia evolved passed into an acid; or it may be passed into acidified nitrogenised organic matter which has been treated with vitriol, whereby a highly ammoniacal substance is obtained which may be used in the manufacture of manure.

In carrying out the first part of this invention the proportion of sulphuric acid or vitriol to be employed will vary according to the materials acted upon. The patentee has found that good results may be obtained when leather clippings are to be utilised by employing the same in the proportion of about 100 parts by weight of leather clippings, and about 75 parts by weight of 70 per cent. vitriol; but these proportions will vary with the several nitrogenised substances employed.

## STRAW ELEVATOR.

WILLIAM TASKER, Jun., *Waterloo Iron Works, Andover, Hants.—Patent dated July* 8, 1868.

THE patentee's invention has reference to improvements in machinery for elevating straw and other produce in such manner that the straw may be taken direct from a threshing machine, being worked therefrom in the usual manner, or it may be worked by horse gear combined with the front or back carriage of the elevator without




the necessity of raising or lowering the whole machine for either mode of working.

The accompanying illustrative engraving is a side elevation of the improved combined machine. A is the front carriage (which may be made of wood or iron), on the top of which the gear work B of any convenient construction is arranged; C is the lever to which the horse is attached; D is the hinder carriage of the elevator in

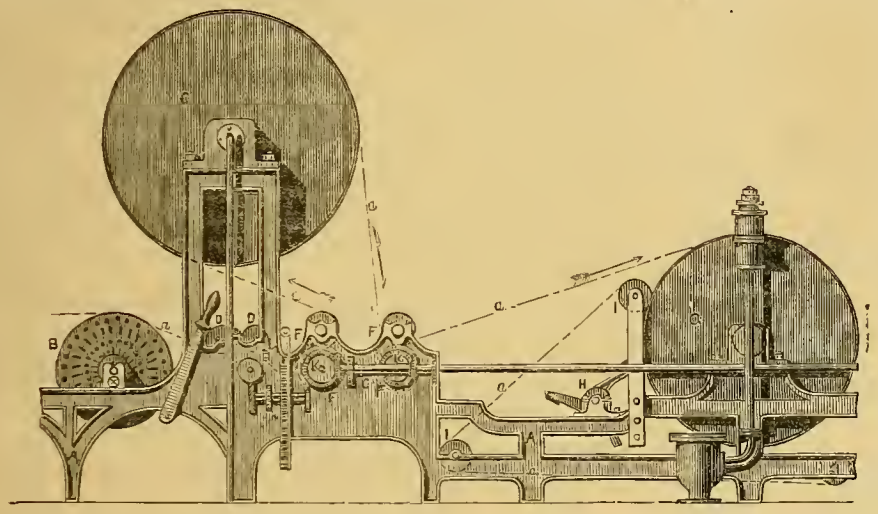
which the gear work may be placed if desired in lieu of in the front carriage as shown; E is the frame of the elevator so arranged as to allow the horse to pass under it; F is the elevating trough, working on the centre G, up which the straw or other agricultural produce is passed by the endless rake H revolving round the drums I I. The trough F may be raised or lowered in the ordinary manner by means of racks and pinions.

## SIZING YARNS.

C. J. Simpson, Walter Simpson, Arthur Simpson, and Frederic Simpson, *Preston, Lancaster.—Patent dated Aug.* 17, 1868.

These improvements relate to the combination and arrangement of apparatus for sizing and drying yarns for weaving, whereby the yarn is better sized and is stronger and smoother than when sized with an equal quantity of sizing used in the ordinary machines, as the size is thinner and strikes more into the core of the thread.

In the subjoined figure A is a portion of the main framing of the machine, B one of the yarn beams or rollers, C the size-trough,



which may be of the usual construction. The warp or yarn *a*, after leaving the beams A, is guided by one or more guide rollers D to the edge of the size-trough, into which it dips, the yarn being made to pass under the immersing roller E, which may be adjustable in height as found desirable. As the under side of this roller is immersed in the size, it follows that the yarn takes up a certain amount of such size, and as the yarn leaves the trough the superfluous size is squeezed from it by causing the yarn to pass between the squeezing rollers F. From these rollers the yarn passes in the direction indicated by the arrow round the drying cylinder G, whereby it is dried preparatory to its receiving a second coating of size, whether such second coating be effected by a second actual immersion in the trough itself, by passing under a second submerged or partially submerged immersing roller like the first one E, or by simply passing between the second pair of squeezing rollers F′, the lower roller revolving in the size and taking up sufficient thereof to coat the surface of the yarn as it passes between the two rollers. After receiving its second coating of size, the yarn passes direct to the ordinary drying cylinder G′, on leaving which it may or may not be subjected, as found desirable, to a current of air generated by the fan H. Any convenient arrangement of guide rollers I may be adopted for directing the course of the yarn after it leaves the second drying cylinder G′. It is immaterial whether the yarn receives its full supply of size from one size trough or from two separate troughs, provided always that the yarn undergoes a drying process between the first and second applications of the size. The lower one of the two pairs of squeezing rollers F and F′ derive each a uniform rotatory motion from the bevel or other gearing K K′, as is well understood, care being taken not to put any unnecessary or unequal strain or tension upon the yarn. After leaving the last one of the drying cylinders the yarn is received on to warp beams in the usual manner.

It will be obvious that this construction of apparatus may also be adapted for using (after the first sizing and drying) a different quality of size or a lubricating material, such, for example, as grease of any kind, which might be applied after the first sizing and drying instead of a second coating of size.

## LAW REPORTS.

Carpet Looms.—Crossley *v.* Dixon. The Rolls Court, March 24, before the Master of the Rolls.

Mr. Grove, Q.C., Sir Richard Baggallay, Q.C., and Mr. Cracknall appeared for the plaintiffs; and Sir Roundell Palmer, Q.C., Mr. Jessel, Q.C., Mr. Speed, and Mr. Theodore Aston for the defendants.

This was an action instituted by the well-known firm of John Crossley & Sons, now Crossley & Sons (Limited), carpet manufacturers, Halifax, with a view to obtain a declaration that the defendants, who are carpet manufacturers at Kidderminster, are liable in royalties on certain looms worked by them, and obtained from the plaintiffs, for a period of about a year prior to the 9th of December 1866, during which period any of the improvements incorporated in the looms were protected by patents belonging to the plaintiff. The patents in question, the last of which expired on the 9th of December 1866, were two of a person named Johnson, which bore date the 8th of March 1852 and the 7th of December 1852, and also two of a person named Collins, which bore date the 1st of October 1852 and the 9th of December 1852, for improvements in the manufacture of Brussels and velvet pile carpets. The defendants' answer to the suit was that in a former suit of "Crossley *v.* Dixon" it had been ascertained and determined what patents were then subsisting and worked by the defendants, and that these patents had all expired by the time when the present suit was instituted, and that the investigations made in the former suit, and confirmed by the chief clerk's certificate showed that what was included in the looms sold to the defendants did not include the patents which were now insisted upon by the plaintiffs; and, secondly, if the first contention failed, then that the looms did not invade the inventions contained in and protected by the plaintiffs patents.

His Lordship thought that the former suit did not dispose of the question. The point at issue in that case was whether certain machines of Messrs. Sharp, Stewart, & Co. which were sold to the defendant Dixon included any of John Crossley & Sons' patented inventions. It was true that the plaintiffs were the same, and the Dixons were defendants, but they had no interest in the matter, which was, in truth, solely a contest between John Crossley & Sons and Sharp, Stewart, & Co., and the latter firm defended the suit from first to last. Accordingly, though the two inquiries were nominally the same, they were so only as between Crossley and Sharp, the first being what inventions were included in and protected by Crossley's patents, and the second, which of the inventions, if any, were made use of in Sharp's machines. The real question at issue in the present suit was only a collateral one, and was not pursued in the former suit; and his Lordship was therefore of opinion that the second question did arise, and that it was his duty to determine whether the looms supplied to the defendant Dixon did include the said patent, or any and which of them. His Lordship had perused the evidence carefully, and found himself unable to determine this question without seeing the machines, and having them explained to him by gentlemen conversant with the matter. If the parties would consent to be bound by his opinion, after examining the machine and having the matter explained to him by two gentlemen, one on each side, he would determine it; if not, he should send an issue to a jury, who should decide whether any, and, if any, which of the inventions protected by the patents was included in the machines supplied by the plaintiffs to the defendants.

Nixey's Black Lead.—Nixey *v.* Roffey.—Court of Chancery, before Vice-Chancellor Malins, March 24, 1869. Mr. Glasse, Q.C., and Mr. Higgins moved in this case to restrain the alleged infringement of the trade of the plaintiff in 'Nixey's Black Lead.' Specimens of both were produced. Mr. Osborne, Q.C., and Mr. Phear appeared for the defendant. His Honour directed the case to stand over until the hearing.

## REVIEWS OF NEW BOOKS.

### SHORT NOTICES.

*Smoking Fires, their Cause and Cure.* By the Rev. Alexander Colvin Ainslie, M.A., Vicar of Corfe, Somerset. Small 8vo.

"Where there is smoke there is fire," says the adage, but where there is smoke there is too often no light—to point out its cause or remedy—if the smoke be that of a house chimney. Domestic smoke is a trying grievance—only second to the continual dropping of a contentious helpmate, as Solomon declares, perhaps from experience—to those who are inside the house; the smoke itself from

tens of millions of chimney-tops, to those who are without, not less disadvantageous, though not quite and, at once, so blackly palpable.

For the latter there appears little hope of remedy; all discontentedly acquiesce in the conclusion that our domestic fire-grates cannot be made to light up and work conveniently, and ventilate the room, and yet not smoke; and so legislation, which has taken the bull by the horns to a great extent as regards manufactory smoke, and might do so as regards steam-ship smoke as well as locomotive smoke, has halted before condemning in penalties the householder, simple or compound, for doing that which nobody can show him how not to do. But the smoke inside, *i.e.* its puffing back, or even in some cases *streaming* back into the room, can be avoided or cured, and ought never to happen, though the fact is that there is scarcely a building even of the first class in these islands in which some of the chimneys do not smoke and often in small private houses the nuisance is intolerable.

That it is due in great part to the practical ignorance of first principles on the part of architects and house-builders, and to the carelessness of both to almost everything but to getting "the job done and paid for," is certain.

A standing proof of this may be seen every day from the Thames n the zinc organ-pipes stretching up along the roof of the Temple Library, as a supplement to the original and useless chimneys overhung by the roof.

And yet there have been many silly and bad, and several good treatises on smoky chimneys, and their prevention or cure. One of the earliest and best is comprised in the article "Smoky Chimneys," in the old editions of the *Encyclopædia Britannica*.

Several separate books subsequently cogged more or less from that. Now we have a new one, and architects and builders, and all sensible people whose chimneys smoke, will do dwell to see what Parson Ainslie has had to say on this text. He has obviously not forgotten in the quiet recesses of Corfe Vicarage, Somerset, and amidst the fragrance of his roses and honeysuckles, "far removed from noise and smoke," either his old college "Pneumatics" or the smoking which he has suffered or seen others suffer, and has written by far the best treatise on the subject that has been produced. "The ascent of heated air and smoke is governed by certain known laws," he says in his introduction; "and the object of the following pages is to explain those laws as concisely as possible, and to point out the causes which most commonly modify or interfere with their action, and produce results *apparently* contradicting scientific theory." He does so in a brief and lucid manner, and then applies these laws to nearly all the examples of smoky chimneys occurring or likely to occur in practice, and deduces rules for guidance that even the least philosophical of bricklayers can scarce fail to comprehend and readily be guided by.

The parson has applied himself to an humble-sounding task, but one greatly more useful to humanity in these latitudes than many which engage so much of the attention of his brethren of the robe just now.

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*Lehrbuch der gesammten Tunnel-baukunst.* Von Franz Rziha. Ernst and Korn, Berlin, 1868.

The fourth part of the second volume of this magnificent work of Rziha's, which we have noticed at length in past pages of the *Practical Mechanic's Journal*, has appeared; and all we need say of it is that it fully sustains the reputation of the preceding parts.

In the present part the Belgian, German, and Austrian systems (for they all differ a good deal) of tunnelling are fully described and critically compared. This is followed by an elaborate comparative critique and estimate of costs, of timber-frame tunnelling, with a chapter or two on the methods of lining with masonry under diverse conditions; and these lead on to the commencing chapters, in which the author is about to describe his own peculiar system and construction of cast- and wrought-iron moveable framing for tunnelling without timber, of which we before now gave a tolerably complete sketch to our readers.

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*Leitfaden zur Bergbaukunde &c.* Von Bergrath H. Lottner. Bearb. u. herausg. von A. Serlo. Erste Liefrg.

We may fitly place this work after that of Rziha, for it treats of a very analogous subject. Tunnelling and shaft-sinking for railways have much in common, and have in fact borrowed much in practice from level and adit driving and shaft-sinking for coal and other mining. These last are the operations here treated of, and treated of with the ability we are prepared to expect from the reputation of Bergrath Lottner, well known in Germany for his grand maps and sections of the coal formations of Westphalia &c. and as a Professor of Mining in the Royal Mining Academy of Berlin. The present part treats mainly of sinking and driving through various "ground," and includes all the new machinery for boring and holing each, and the new and old explosive agents. The work will be completed in three large parts (or volumes, we may almost call them,) with many illustrations by excellent woodcuts; and the successive parts will embrace every head of subject belonging to the miner's art, so far as the entering the ground, securing it, and keeping the shafts, &c. level water and foul air free, are concerned. It excludes, as belonging to metallurgy proper, the treatment of the material, of whatever sort, extracted by means of the excavations made.

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*Geschichte der königlichen Berg- und Forstakademie in Schemnitz.* Herausg. von Gustav Faller, &c. &c. Jeorges, Schemnitz, 1868. Small 8vo.

This is a history of the rise, progress, changes, successive improvements, and present state of the Mining Academy of Schemnitz; and the publication has been suggested apparently by the fact that this ancient and dignified school of mining &c. will celebrate its centenary of useful exertion in the year 1870. We commend this little work to our readers who take an interest, such as they ought, in the improvement of technical education of every sort in our own country, and to our legislators on education, of the House of Commons, as enabling them there to compare our existing British Mining School with one, one only, of the many that have so long existed, flourished in, and been of incalculable advantage to Germany.

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## CORRESPONDENCE.

☞ We do not hold ourselves responsible for the views or statements of correspondents

### CRAIG *v.* McFARLANE.

TO THE EDITOR OF THE PRACTICAL MECHANIC'S JOURNAL.

Sir,—Having observed in your March number a report of the hearing before the Solicitor-General, on the opposition to McFarlane's Patent, which is inaccurate in some particulars, I venture to send you an account of the proceedings, which, so far as it goes, may be relied on for accuracy. And I am the more disposed to take this course as yours is a journal which (most deservedly, as it appears to me) has the character for affording correct information on the subject of patents.

I am, Sir, your obedient servant,

8 Quality Court, WILLIAM SPENCE.
*3rd April* 1869.

Hearing, 29th January 1869.

*Objections entered on behalf of Mr. Craig.*

"That I have reason to believe that the said John McFarlane is not the first and true inventor of the said invention, but that the same is the result of communications made to him by myself."

*Reply to objections on behalf of Mr. McFarlane.*

The highest date alleged as that at which Mr. Craig began his experiments is 24th September 1867. But a metal roller covered with vulcanite, and over that with india-rubber, was sent by Mr. McFarlane to Mr. McMurray for trial in a paper-making machine in August 1867, and this was after communications extending backwards to the early part of that year. Mr. McFarlane therefore had the idea of applying rollers of this kind to paper-making machines in his mind before the highest date mentioned by Mr. Craig, and could not have derived the invention from his communications as alleged.

This was in substance what was submitted to the Solicitor-General by Mr. Spence in reply to the above objections.

On both parties being called in, Mr. Grove said that what he had stated was in substance, that as Mr. McFarlane had not himself conducted the experiments on the couch roller supplied to Mr. McMurray at Wandsworth, and as Mr. Craig had been the first to make a successful application of the under press roller, it seemed to him the best course for Mr. McFarlane to have a patent for couch rollers and Mr. Craig for press rollers.

This arrangement being assented to by Mr. Spence on behalf of Mr. McFarlane, the Solicitor-General decided that both patents should be granted on the above terms.

An undertaking to abide by these conditions (and on the part of Mr. McFarlane to abstain from opposing Mr. Craig's patent) has since been prepared at the Solicitor-General's chambers, and being signed by the agents of the respective parties will be retained there as a record of the decision.

# PROCEEDINGS OF SCIENTIFIC SOCIETIES.

## THE INSTITUTION OF CIVIL ENGINEERS.

March 2, 1869.—The first Paper was "On Sinking Wells for the Foundations of the Piers of the Bridge over the River Jumna, Delhi Railway," by Mr. Imrie Bell, M. Inst. C.E.

The author described the mode of forming the fonndations of the bridge over the River Jumna, near Sirsawa, on the Delbi Railway. It appeared that the bed of the river at this point consisted of coarse and fine gravel and sand, interspersed with layers of blue clay 3 feet and 4 feet thick, and covered with silt; but during the rainy season large bonlders, weighing 14 lbs. each and upwards, were bronght down, and deposited by the scour of the river 30 feet below the level of the bed. The bridge comprised twenty-four openings, each 99 feet in the clear, and the superstructure was composed of two lines of lattice girders, resting on brick columns, or wells, each 12 feet 6 inches external diameter, and 5 feet 10 inches internal diameter, so that the wall of the well was 3 feet 4 inches thick. In some instances the sites of the piers were got clear of water by diverting the river at different points during the dry season, while in otber cases islands were formed, by driving a half-circle of piles on the up-stream side, then lowering sand bags on the down-stream side, to the height of 4 feet or 5 feet, and afterwards filling np with sand to 5 feet above low water. The curb on whicb the steining of the well rested was formed of wronght-iron plates and angle irons riveted together; and in cross section the curb was like an inverted right-angle triangle, of which the height was 4 feet, and the base 3 feet 4 inches. When each curb was complete, it was moved into position, and the compartments were then filled in with concrete. The curb was next sunk by men working with the "phaora" or spade and basket, till the upper edge was within 3 inches of the level of tbe water, when a ring of brickwork was carried np for a height of 6 feet. Tbe excavation of the interior was again proceeded with, by means of the "jham" and divers in the old native style; afterwards a further height of 10 feet of brickwork was added, bnt tbe material wss now removed by a sand-pnmp, worked by a steam hoist of 4 h.p., as was the case after two additional lengths, each of 15 feet, were bnilt, when the well was carried down to its full depth. In operations of this nature great care was necessary, especially at first, to ensure the well, or cylinder, descending vertically.

The lime used at the works was made from marl, or, more properly, calcareous clay, which, wbile soft, was roughly moulded into bricks. These were stacked to dry for three or four days, and were afterwards burnt with wood in kilns for fifty or sixty hours. The flues were then closed with bricks and mud, and so allowed to remain for two or three days. On the kiln being opened, the lime bricks were unloaded almost in a whole state, were ground under stones, screened, and carried to the works pure and free from ash or dirt. Tbe mortar was made from one part of ground lime and one part of clear, sharp sand. This mortar was used in all the well fonndations of the bridge np to the level of low water; and as a proof of its qnality, it was stated that it was easier to break the work as a mass than to separate it at the joints or beds. Above the level of low water the mortar was composed of white hill lime, and soorkhee, or crushed brick bats, in equal proportions, as it was fonnd that the lime from the calcareous clay lost the greater part of its cohesion when used in work exposed to the vicissitudes of the atmosphere: whether this arose from the frequent changes from dryness to humidity, or from heat to cold, was not ascertained.

Tbe novelty in the sinking of the wells of this bridge was in the nse of the sand-pnmp. This was described tn consist of a wronght-iron cylinder, having a pump riveted to it at the top, in which was a piston fitting loosely, and pierced with small boles to allow of the escape of water. The piston rod terminated in an eye at the npper end, to which a chain could be attached. The bottom of the cylinder was moveable, and in the centre there was an upright suction pipe, projecting outwards for a distance equal to its own diameter, and inwards nearly to the top of the cylinder. When the pump was lowered to the bottom of the well, the chain attached to the piston rod was worked np and down like a ringing engine. In tbis way water was first drawn through the upright pipe, followed by sand or other material, which fell over the pipe into the cylinder. This operation was contintned nntil the cylinder was qnite full, which was known by tbe piston working stiffly, when the machine was raised to the snrface; the bottom of the cylinder was then detached, with the column of sand resting on it, and another cylinder bottom which had been cleared of its sand was substituted. The number of men employed at each well was fonrteen; nine working the chain, two clearing away the stuff brongbt up by tbe pnmp, one in charge of a steam hoist, one breaking firewood, and an overseer. The average rate of sinking, including contingencies, was about 6 feet in eight hours. This rate was extraordinary when compared with the old system of the "jham" and diver, and would, it is believed, materially reduce the expense of bridge work in India.

The second Paper was a "Description of Apparatus for Excavating the Interior of, and for Sinking, Iron Cylinders," by Mr. John Milroy, A.I.C.E.

It was believed that, for the purpose of sinking cylinders, the great desideratum hitherto had been some method of excavating the earth from the interior without at the same time having to take ont the water, and to keep it out during the operations. This object seemed to the anthor to have been attained by a machine of his invention, which was nsed in the construction of the bridge over the River Clyde for the Glasgow (City) Union Railway, to which Mr. Fowler (Past President Inst. C.E.) and Mr. Blair (M. Inst. C.E.) were tbe engineers.

The excavating apparatus, commonly called the "Excavator," was thus described:—It consisted of a horizontal frame of iron, with an outside rim nine inches in heigbt, to whicb radiated, like the spokes of a wheel, T irons from a small cast-iron ring in the centre. To the bottom of the ontside rim were hinged eight heavy iron spades, which, when drawn in, fitted closely, with their points pressing against the inner ring. The hinges of the spades were so constructed as to prevent them from turning back beyond the perpendicnlar. The whole apparatus was very strongly made, and it formed when closed a nearly water-tight tray. When the machine was descending, the spades were allowed to hang vertically, and they were forced into the ground, by the aid of two chains, fastened to the top of upright arms on opposite sides of the Excavator, then passed down the cylinder, under a pulley, up between two leaders, and over anotber pulley, the end of each chain being wound round the large axle of a capstan, or drum on the landing stage. These chains were calculated when tightened to keep tbe machine down, whilst the spades were being drawn in through tbe ground and up to the frame. This was effected by a second set of chains, all of equal length, and each fastened at one end to the inside of a spade, and at the otber to the end of a main chain, by which the machine was raised to the surface, with the earth it contained, by means of a steam hoist. In order to enable an opinion to be formed of the capabilities of tbe Excavator, it was mentioned that the progress of the excavation, and the corresponding subsidence of the cylinder, reached from about 12 feet to 20 feet per day of ten hours, inclusive of the time employed in adding fresh lengths of cylinder, putting on weigbts, &c. When there had been little interruption for any of these purposes, it had amounted to 25 feet in the ten hours, and then the average qnantity of sand brought up at each lift was 21 cubic feet, and the total quantity during the day was found by measurement to be 70 cubic yards. Twelve men in all were employed—viz., one engineer, one stoker, six men working the drums, three attending to the loading and discharging of the Excavator, and one man wheeling away the materials.

## ROYAL INSTITUTION OF GREAT BRITAIN.

February 5, 1869.—On "Tree and Serpent Worship, as exemplified by some recently discovered Indian Monuments," by James Fergusson, Esq., F.R.S.

Tbe speaker introdnced the subject by explaining the difficulties which arose in treating of it, partly in consequence of the reckless manner in which a certain class of antiquaries had theorised regarding serpent worship, but more because, as a result of this, all the better class of critics had been deterred from meddling with what had become the laughing-stock of sober-minded persons, in consequence of the absurdities which had been engrafted upon it.

The first monument bearing on tbe subject was the Temple of Nakhon Vat, in the centre of the now desolate country of Cambodia, whicb was discovered about ten years ago, almost accidentally, by a French traveller, M. Mubot. It is probably not too much to say that, taken altogether, it is probably the most remarkable temple in Asia, being one of the largest, and is unsurpassed by any in the extent and the beauty of its form, and the marvellous elaboration of its sculptural details. On examination, it was fonnd that this temple was erected, by an Indian colony from Taxila, as late as the 13th century of the Christian era, and was dedicated wholly to the worship of the serpent.

Tbe next piece of evidence was brought to light even more accidentally. While looking for objects to cast for the Paris Exhibition of 1867, a large collection of sculptures in white marble were discovered buried nnder rubbish of all sorts in the stables of Fife House, then occupied as a temporary museum attached to the India Office. On examination, it was found that these had been sent home some twelve years ago, by Sir Walter Elliot, having been principally excavated by him from the Amravati Tope, a building of the 4th century, situated about 60 miles from the mouth of the Kistnah river in the Zillah Guntoor.

The building to which tbese marbles belonged was originally enclosed by a circular screen 195 feet in diameter, or exactly double the dimensions of the corresponding screen at Stonehenge, the height of the two circles being very nearly the same. Within this was a procession path, 12 feet in width, and then an inner screen only 6 feet in height, but even more elaborately ornamented with carvings than the outer enclosure. The interior of the Tope inside these two circles was occupied by a number of buildings, all of which have been destroyed, and their materials used by a local Rajab in building the town of Amravati, at the end of the last century.

On examination, it was found that the Tope had been erected in the 4th century, and was in all essentials a Buddhist monument; but its sculptures proved that the worship of the seven-headed Naga, or Serpent-god, was nearly as important and as prevalent when it was erected as that of Buddha himself. Another circnmstance, nearly as unexpected, was tbat the worship of the Tree was equal in dignity to that of the Serpent—the three forming a trinity for which we were by no means prepared.

The earliest written notice of the worship of trees and serpents is that contained in the 2nd and 3rd chapters of Genesis. With the knowledge we now possess on this subject, it appears reasonable to assume that the curse therein recorded on the serpent was not against the reptile as such, but the expression by a Semitic people of their abhorrence of what they considered a degrading superstition, which it was necessary should be anathematised and swept away in order to make way for the purer and higher worship of Jehovah, which it was the great object of the writers of the Pentateuch to introduce. In so far as the Jews were concerned, the abolition seems to have been successful; but when tbey come in contact with the Canaanites it again crops up occasionally. As, for instance, when the Lord is said to have appeared to Moses in a flame, issuing from a sacred tree, on which occasion the prophet's rod was turned into a serpent. A still more remarkable instance was tbat of the brazen serpent, which Moses erected in the desert to cure the Israelites from the bites they were suffering from. Though we lose sight of this image for a while, it appears that the Jews burnt incense and made offerings to it down to the time of Hezekiah, and that it was during these 600 years kept in the temple with the Ashcrahs or Groves, which were the symbolical trees of this form of worship. It reappeared after the time of Christ in the form of the sects of Ophites; and in so far as we can trust coins, prevailed in all the cities of Asia Minor in which the seven churches were first established.

In conclusion, the author pointed to certain forms of Dolmens, stone circles menhirs, and such like rude stone monuments, found in India, identical in form and purpose with those found in Africa, in Brittany, and nearly all over the world wherever a Teranian people can be traced. These are not necessarily old, though some of them may be of any age: others were certainly erected in India within the limits of this century, and are undistinguishable from the older examples; showing how persistent certain forms of faith are when once adopted by certain races of mankind. Among these the Turanians are certainly the most instinctive and least progressive

## INSTITUTION OF NAVAL ARCHITECTS.

March 19, 1869.—The first Paper was one by Mr. S. M. Saxby, R.N. "On the Qualities of Boiler Plates." The author was permitted to make a series of experiments at the Enfield Small Arms Factory, for the purpose of testing the quality of the iron used in small arms by means of magnetism. Following the instructions of Colonel Dixon, the author applied the magnetic test to a gun-barrel at the several stages of its manufacture. At each stage a defect was detected near the muzzle and extending some inches downwards. A portion was cut off and the barrel was then tried with an overcharge of powder—it bore this without fracture—yet it still exhibited signs of unsoundness when tested by the magnet. After several severe tests the barrel was burst, and on cutting up a fragment of the metal and submitting it to the microscope, intermixtures of sand with the metal were clearly detected. At Woolwich Mr. Saxby tested a steel cylinder intended for a 3 in. bore 9-pounder, and found a portion of the mass indicated strongly a different magnetic condition; this upon subsequent examination proved to be exactly the case. Now the cost of this mode of testing as compared with the present system, is that of farthings to thousands of pounds sterling, and with a corresponding reduction of labour. The author's mode of testing has also been applied successfully to the testing of rolled boiler plates to ascertain their purity.

A Paper by Professor W. J. Macquorn Rankine, C.E. "On the Calculation of the Stress in Propeller Shafts" was then read.

Mr. J. S. Thorneycroft, C.E. followed with a Paper "On the Resistance Opposed by Water to the Motion of Vessels of Various Forms, and the way in which this varies with the Velocity."

Staff Commander Bourchier, R.N. presented a Paper "On the Preservation of Life at Sea, by Lifebuoys and Rafts." The author described the arrangement of the lifebuoy: it consists of a hollow oval casing, which can be suspended on the person like an ordinary life-belt. The space between the inner and outer casing will contain about three and a-half cubic feet of air, and leave a sufficient space for a supply of fresh water, in the event of a person being compelled to remain adrift for a considerable time. This water space is fitted with two tubes and india rubber mouthpieces. The apparatus is further supplied with means for indicating its position as well as signalling by day or night.

The following Papers were read subsequently:—"On Copper Sheathing for Iron Ships, considered at the present stage of our experience," by John Grantham, member of the Council;

"On Zinc Sheathing for Ships," by Mr. Benjamin Bell. In the discussion which followed the reading of this Paper, the majority of speakers concurred that in the choice of the two metals copper and zinc, copper was to be preferred.

## THE LONDON ASSOCIATION OF FOREMEN ENGINEERS.

The members of this institution met on Saturday, the 3rd ult., in their new hall at the City Terminus Hotel, and the assemblage was much more numerous than at any previous monthly meeting. Mr. Newton was in the chair. After the election of several new members, Mr. Newton delivered an address. He congratulated his fellow-members upon the advancement which the Association was making, and upon their having obtained a suite of apartments so well adapted for their monthly gatherings. It was in 1855, when the society was in its infancy, and when it was regarded with a considerable amount of jealousy and distrust by employers, that he (Mr. Newton) had joined its ranks, and he was thankful he had lived to witness its development to its present state, and the disappearance of every vestige of antagonism to it on the part of the master engineers of the kingdom. To the scientific Press of London much of the success of the Association was due; through its medium the transactions of the society were made known to the engineering community at large.

Mr. Newton adverted to the gratifying fact that Dr. Percy and Professor Tyndall had promised papers on future occasions, and that thus there would be a welding, as it were, of scientific deduction and practical knowledge in their proceedings.

By co-operation of this kind all would be benefited intellectually, and the information gained at the meetings would be utilised in the factory, so as to be made advantageous to employers. The chairman appealed to honorary members to come forward and assist the society by reading papers, and by joining in discussions. They might enter that hall without any sacrifice of dignity, and their presence would be hailed with the greatest satisfaction.

Mr. Robert B. Vinicombe, of the Royal Arsenal, Woolwich, followed with a paper on "Gunpowder Machinery." The paper was copiously illustrated with diagrams, and was altogether calculated to enrich the transactions of the institution.

## ROYAL GEOGRAPHICAL SOCIETY OF IRELAND.

Growth of Bogs.—At the March meeting of the society, held in Trinity College, the above subject, which had been introduced at the January meeting in an able paper by Professor Stokes, was treated, in continuation, in two papers by Mr. Scott Moore, and a third by M. Alphonse Gages.

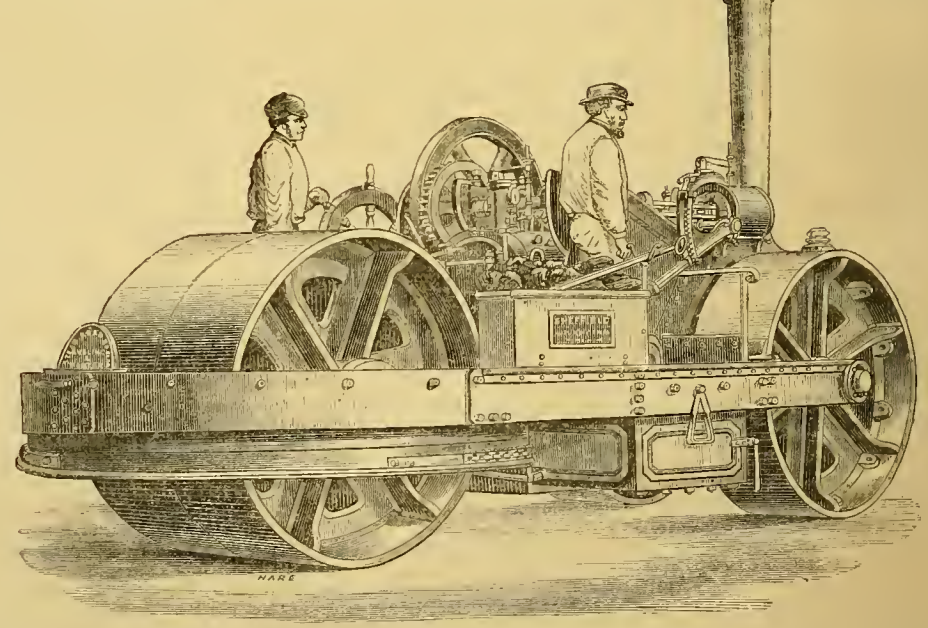
Dr. Macalister said the fourth volume of the *Edinburgh Philosophical Journal* contained two papers on the growth of bog, by a very careful geologist of the old school, Dr. M'Culloch. He distinguished three species of bog—namely, marsh bog, mountain bog, and forest bog, and described plants peculiar to each. The marsh bog was, he said, of the quickest, and the mountain of the slowest growth, the forest being intermediate; but the rate of growth of each was also dependent upon favourable or unfavourable conditions. He spoke of a Roman road having been found under a bog, but did not mention the locality, and also spoke of coins having been found at different depths, without saying any more about them. He (Dr. Macalister) had seen in the parish of Drone, in Perthshire, a rocking stone of undoubtedly artificial character, probably Druidical origin, situated in a wild expanse of bog. It was about nine feet long by five feet high, was balanced on a trachyte base, and surrounded, not extensively, by an area of mountain bog. In no place was that bog thicker than nine or ten inches. In other places, including the island of South Uist, he had seen bog resting on hard rock, and it was seldom of any degree of thickness. In tracing bog along a mountain side he had found that which was before but a few inches in depth to expand in a crevice to a few feet. So that in mountain bog thickness afforded no indication as to age. In moderately dry mountain bog there were very little traces of sphagnum.

The Rev. Maxwell Close observed that the weather exercised an influence in denuding mountain sides of the bog, which, through other influences, tended to grow upon them.

The Rev. Dr. Haughton, F.T.C., said he had to request leave to bring before the society an interesting phenomenon observed by Mr. Gilbert Sanders at the gas-works in this city, which afforded an artificial illustration of the growth of a stone not well known in this country, but very well known in places where oolitic or bassilic formations occurred—namely oolite. Oolitic limestone was composed of small round particles, so called from their resemblance to the roe of a fish. At the pumps in the gas-works quantities of small pebbles were occasionally tossed about by the flow of mingling streams of water. These were found to be coated with a solution of lime salts deposited from the water, which was artificially impregnated with it. If a quantity of them were supposed to gather together, and to lie at rest for a sufficient time, the result would be a pisolitic rock. On coasts in the West Indies, where the sea bottom afforded a solution of lime salts, which was deposited upon pebbles, the formation of rock in this manner had been observed.

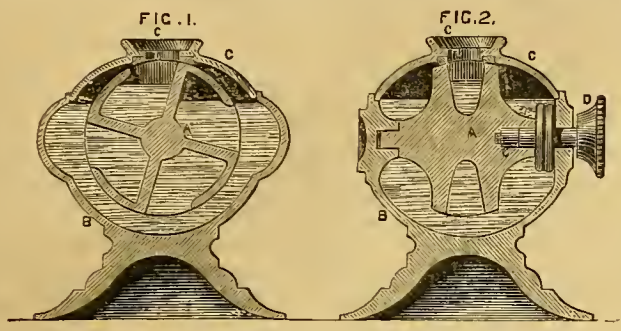
## MONTHLY NOTES.

Road-Rolling for Macadamised Roads.—The annexed figure illustrates the well designed steam road roller constructed by Messrs. Aveling & Porter, engineers, of Rochester. Whilst the wheels beneath the engine end are fixed in position, those in front of the machine, which constitute together the roller proper, are movable about a vertical axis within certain limits: the common axle and frame thus far rotating upon a sort of turntable or continuous circumferential bearing ring, a very stable and simple arrangement. The whole machine is tractable in a high degree; and while capable of doing much good, is incapable of doing damage to any macadamised or paved road. It is one of the marvellous



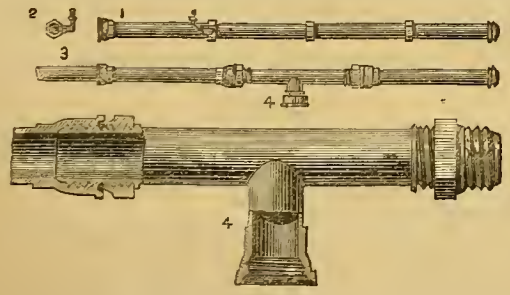
examples of our social inertia, stupid unchangeableness, that almost justifies the saying of the Germans that we are like Chinese in some respects — that year after year, and for at least one-tenth—oftener for one-sixth—of the year many macadamised roads and streets in and out of London are rendered scarcely passable, and incalculable damage done to horses and vehicles, and much suffering inflicted on both men and brutes, by the existing barbarous (method, shall we call it?) of sheeting over with loose stone, and leaving that to be tossed about and at length ground in, or to powder, by wheel traffic, in place of being at once blinded with gravel and consolidated to a good road surface by the use of road rollers such as these.

STOLTZ' INKSTAND.—M. Stoltz has recently designed a novel kind of inkstand, the chief peculiarity of which consists in the use of a cupped disc, capable of rotating in either direction, which preserves the ink from contact with the air when not in use, and by turning which, when required for use, the ink is raised entirely free from sediment or extraneous matters, whilst the quantity may be varied according to circumstances. Figs. 1 and 2 represent vertical sections taken at right angles, the one to the other, of this improved inkstand. A is the disc, provided with four cups or cavities, and enclosed within the stand B, containing the ink; C is the lid or cover, in which is formed an aperture *c* for the passage of the pen, and D is a handle for turning the disc. By turning the disc to the right hand its four cups are filled, and raise the ink to within a short distance of the aperture *c*; these cups, being wider towards the periphery of the disc, form a funnel, and when




they are in a vertical position the ink returns into the lower part of the cup, so that the quantity contained therein, by reason of the form of the cup, is brought to a greater height, and thus facilitates its use. The pin e, which carries the handle, is screwed into the disc, india-rubber washers *r* being interposed, which effect an hermetic junction between the pin and the inkstand, and at the same time maintain the disc in its place; a perforated india-rubber washer *i* is also provided between the disc and the cover, in order to completely intercept, when required, the passage of the air. The disc A being a short distance from the bottom of the box, whilst it raises nearly the whole of the ink, the sediment remains at the bottom; and by turning the disc towards the left hand the ink not required for use flows again into the inkstand and remixes with its contents. When four cups are employed, as shown in the engravings, at every quarter-turn a cup is presented beneath the aperture *c*, and at every half-quarter turn the orifice is closed by the solid portion of the periphery of the disc.—*Génie Industriel.*

BARKER'S PATENT GAS AND WATER PIPES.—The accompanying engraving represents an improved mode of fitting and arranging pipes for conveying gas and water, and recently patented by Mr. C. M. Barker, of 12 Kennington Park Road, London. Fig. 1 represents a length of pipe cast according to the patentee's improvements, with hexagonal bands at regular distances asunder, and with screwed spigot and socket ends. These bands admit of service pipes being readily attached to the main pipe on either side, great facility of connection being afforded by the flat surface of the band into which the service is screwed as shown in the transverse section. In addition to the screw on the elbow of the service pipe, there is also fitted a back nut, which serves as an additional means of sealing and strengthening the joint, so that it is almost impossible that the slightest leakage can take place; whereas, in the ordinary mode of connecting, there is a very considerable loss from this cause. The ends of the pipe are cast with screwed ends, as shown more particularly in the enlarged partially sectional figure. In fitting these pipes together,




the conical socket of each length merely requires a lining of ordinary cement to be put in it, and on being screwed up the plastic material is squeezed around the end of the entering pipe, and in this simple manner a perfectly firm and air-tight joint is obtained. This system of connecting the several lengths of pipes gives increased rigidity to the series and tends to prevent deflection, which is such a serious evil in the ordinary system of laying pipes, and, as is too well known, causes an enormous amount of waste. In order to provide for effecting a junction with existing mains, certain lengths of the pipe are cast, as shown in figs. 3 and 4, with a lateral lengthening screw socket, by means of which it may be readily connected with the old main, and at little cost. The improvement in these pipes is self-evident, at the same time they are not heavier than those at present in use, nor do they involve additional expense, and we hope to see them ere long brought into use extensively.

SOLAR ATMOSPHERE.—A paper has been sent from Simla in India to the French Academy in which the author, Mr. Janssen, has communicated the discovery of a hydrogen atmosphere round the sun. He considers this atmosphere to be one of the two elements of the future sea. He has also demonstrated the existence of a connection between the solar spots and the protuberances.

## APPLICATIONS FOR PROVISIONAL PROTECTION FOR INVENTIONS UNDER THE PATENT LAW AMENDMENT ACT.

☞ When the city or town is not mentioned, London is to be understood.

*13th March* 1869.

773 H. C. Bartlett, Garlick Hill, and A. G. Southby, Bulford, Wilts—Paper-making
774 W. H. Harfield, Royal Exchange Buildings—Capstans and capstan windlasses
775 J. B. Palmer, Old Ford, Bow—Matches and fuses
776 H. Delattre, Roubaix, France—New kind of tissue
777 P. B. O'Neill, Paris, and W. H. H. McNeight, Dublin—Raising, lowering, and suspending blinds and shutters
778 E. W. Slade and M. Slade, Wilton, Wilts—Portable oven or cooking apparatus
779 J. Thomas, Birmingham—Repeating firearms
780 C. Vero, Atherstone, Warwick—Hardening and felting the bodies of hats
781 J. Thomlinson, Carlisle, and W. Thomlinson, Loughborough—Paper and textile fabrics
782 W. T. Carpenter, Isle of Sheppy, Kent—Manufacture of gas
783 W. R. Lake, Chancery Lane—Breech-loading firearms.—A com.
784 J. Tenwick, Grantham, Lincoln—Annealing ovens and kilns

*15th March* 1869.

785 J. Henderson and T. Brown, Kirkcaldy, Fife—Water cocks or valves
786 W. A. Marten, Union Street, Southwark—Diffusing heat and promoting the generation of steam
787 E. Sands, Manchester—Motive power
788 J. C. Shaw, Manchester—Traverse card grinder.—A com.
789 C. D. Abel, Chancery Lane—Healds and heald frames—A com.
790 H. D. Rawlings, Nassau Street, Portland Place—Filling bottles with aërated liquids
791 J. G. Jennings, Lambeth—Preparing sewage
792 G. P. Evelyn, Pall Mall—Sails, yards, and rigging of ships' vessels
793 J. R. Cooper, Birmingham—Breech-loading firearms
794 W. R. Lake, Chancery Lane—Steam vessels.—A com.
795 W. R. Lake, Chancery Lane—Multiple drilling machine.—A com.

*16th March* 1869.

796 J. Taylor, R. Ingham, J. Ingham, and J. Sharplis, Crawshaw Booth, Lancaster—Carding engines
797 W. A. Lyttle, Hammersmith—Sustaining and insulating electro-telegraphic wires
798 W. McAdam and S. Schuman, Glasgow, N.B.—Packing bottles
799 O. Whittaker, H. Wallwork, and I. Wallwork, Hurst, Ashton-under-Lyne, Lancaster—Top and bottom bearings for shafting, and rollers
800 F. Render, Manchester—Transport of minerals and merchandise upon railways
801 W. Campion, Nottingham—Sewing machines
802 W. Robertson, Manchester—Self-acting mules and twiners
803 L. Engel, Milk Street—Umbrellas, sunshades, and parasols
804 J. L. Norton, Ludgate Hill—Looms for weaving
805 W. Catt and C. S. Catt, Ipswich—Joints of carriage shafts and connecting splinter bars to carriages
806 E. Roper, Garrick Street, and G. Shaw, Stoke-upon-Trent, Stafford—Printing blocks, plates, and cylinders

*17th March* 1869.

807 J. James, Princes Street, Lambeth—Compressing powders into pellets
808 E. W. P. Gibbs, Westbourne Park Crescent—Velocipedes
809 B. Latham, Westminster—Filtering and straining liquids
810 T. Rickett, Birmingham—Velocipedes
811 J. J. G. D. J. M. Agnellet and H. D. Dubois, Paris—Manufacture of pulp
812 H. Clanghton, Dumbarton, N.B.—Screw-propellers
813 J. Heywood, Tonge, F. Murphy, Middleton, and J. Wild, Tonge, Lancaster—Tapes and looms for weaving them
814 M. Rourke, Manchester—Textile fabrics and paper for oil and floor-cloths
815 J. Carter, Nottingham—Chemical night-soil closets
816 H. Starr, Moorgate Street—Safety-hook for harness.—A com.
817 F. Gillham, Liverpool—Hats
818 J. H. Bennett, Leith, N.B.—Steam-engines and boilers
819 C. F. Claus, Middlesbro-on-Tees, York—Manufacture of carbonate of potash

*18th March* 1869.

820 J. Ramsbottom, Crewe, Chester—Ventilating railway tunnels
821 T. Martin, Formby Lancaster—Supplying ammunition to troops under action
822 G. R. Mather, Wellingborough, Northampton—Cutting or giving form to wood
823 J. C. Ramsden, Bradford, York—Looms for weaving
824 E. Booth, W. P. Gaulton, and J. Walls, Ashton, Manchester—Furnaces
825 J. H. Johnson, 47 Lincoln's Inn Fields—Fircarms, ordnance, and cartridges.—A com.
826 J. T. Darke, Walton-on-Thames, Surrey—Treating sewage and the manufacture of manure
827 A. De Pindray, Paris—Smoke-consuming apparatus for steam generators
828 W. R. Lake, Chancery Lane—Anchors.—A com.
829 S. Haycraft, Birmingham, A. Haycraft and S. Haycraft, Strond, Gloucester—Steam-engines
830 J. Partington, Oldham, Lancaster—Smoke-consuming apparatus
831 W. T. Sugg, Vincent Street, Westminster—Gas-burners
832 A. B. Walker, Liverpool—Applying heated air to various useful purposes
833 J. Ritchie, Leicester Square—Fly-wheels
834 J. Cox, Edinburgh—Velocipedes

*19th March* 1869.

835 E. A. Inglefield, St. John's Wood—Steering apparatus
836 J. Thomas, Middlesbro-on-Tees, W. Bacon, Newcastle-upon-Tyne, and H. Groves, Redcar, York—Manufacture of iron and steel
837 F. W. Fox, Bristol, Gloucester—Locomotive engines and carriages
838 A. Albini, New Broad Street Buildings—Repeating or revolving firearms
839 C. G. Bonchill, Birmingham—Breech-loading firearms
840 J. Jack, Liverpool—Construction of ships for auxiliary screw-propellers
841 E. T. Hughes, Chancery Lane—Weighing-scales.—A com.
842 S. Fox, Decpcar, Sheffield—Permanent way of railways
843 A. V. Newton, Chancery Lane—Obtaining motive-power for sewing-machines.—A com.
844 W. R. Lake, Chancery Lane—Waterproof overshoes.—A com.
845 C. E. Brooman, Fleet Street—Use of petroleum and other oils for heating.—A com.
846 S. R. Wybrants, Dundee, N.B.—Textile fabrics

*20th March* 1869.

847 J. Hamilton and R. Paterson, Glasgow, N.B.—Treating, preserving, and conveying fermentable and aërated beverages
848 F. D. Nuttall, St. Helens, Lancaster—Reverberatory furnaces
849 J. D. Morrison, Edinburgh, N.B.—Heating and ventilating buildings and ships
850 H. Whitehouse, Tiptou, Stafford, and W. Probert, Oldbury, Worcester—Tuyeres for blast furnaces
851 F. Holmes, Hatcham Road, Surrey—Pulley arrangements applicable to blind cords
852 W. L. Wrey, Westminster—Toothed gearing

853 J. V. Robinson, Dublin—Production of negatives for photographic printing
854 F. E. Duckham, Millwall—Governors for marine engines
855 J. Kay, Glasgow, N.B.—Mouthpiece of wind instruments
856 H. E. Newton, Chancery Lane—Measuring liquids.—A com.
857 H. E. Newton, Chancery Lane—Motive-power engines.—A com.

*22nd March* 1869.

858 W. H. Phillips, Nunhead, Surrey—Apparatus for discharging water for extinguishing fires
859 W. R. Lake, Chancery Lane—Hay-tedding machine.—A com.
860 J. Booth, Birmingham—Indexes of account-books
861 J. Loader, Worship Square—Apparatus for injecting water into steam-boilers
862 G. Lander and G. Cope, Liverpool—Twisting or spinning tobacco
863 T. Carrodus, Keighley, York—Self-coupler for railway engines, carriages, and wagons
864 W. G. Crossley, Cambridge—Construction of wheels
865 W. Crossley and J. W. Swithenbank, Bradford, York—Shuttles
866 E. G. Reuss, Sheffield, York—Table cutlery
867 H. Vansittart, Richmond, Surrey—Screw propellers
868 J. Combe and J. Barbour, Belfast, Ireland—Transmitting rotary motion
869 M. Tildesley, Willenhall, Stafford—Manufacture of door bolts
870 E. Stacey, Cavendish Square, and J. Thomson, Peckham—Apparatus for purifying gas
871 M. Sigler, Paterson, New Jersey, U.S.—Regulating the tension of warp
872 J. J. Hicks, Hatton Garden—Stoppers for perfume and other bottles
873 J. E. Emerson, Trenton, New Jersey, U.S.—Rocking and reclining chairs
874 G. T. Bousfield, Brixton, Surrey—Felting cloths.—A com.
875 A. Clark, Rathboue Place and Chancery Lane—Mixing paints, chemicals, and fertilisers.—A com.

*23rd March* 1869.

876 J. Nicol, Stirling, N.B.—Envelopes
877 R. Gregson, Wigan, Lancaster—Fire-bars for furnaces
878 G. Blanche, Paris—Attaching purses to the pockets of clothing
879 C. Longfield, Birmingham—Cramps for flooring boards
880 J. Macintosh, Regent's Park—Elastic fillets or bands for boots and shoes
881 L. A. Israel, Minories—Manufacturing sulphuric acid
882 C. de Bergue, Strand—Making holes in metal
883 J. Fryer, Redcar, York—Rotary cultivator
884 J. H. Johnson, 47 Lincoln's Inn Fields—Artificial stone blocks.—A com.
885 F. Rudrum, Norwich—Velocipedes
886 J. Horsley, Cheltenham, Glocester—Protecting nitro-glycerine for conveyance and storage
887 F. de Bowens, Pennsylvania, U.S.—Machinery for making match splints

*24th March* 1869.

888 M. F. Maury, Dorset Square—Heating railway carriages, vessels, and buildings by electricity.—A com.
889 J. B. Fell, Newton-in-Cartmel—Locomotive engines, carriages, and permanent way
890 R. W. Page, South Molton Street, Oxford Street—Garden and fire-engines
891 W. Harrison, King Edward Street—Sunshade.—A com.
892 C. McDermott, Liverpool—Press for applying eyelets and paper fasteners
893 F. J. Maneeaux, Paris—Firearms
894 V. Chémery, Sedan, France—Damping and pressing the surface of cloth
895 J. Nevill, Abergavenny, Monmouth—Securing window sashes and blinds
896 W. E. Newton, Chancery Lane—Working heavy guns.—A com.
897 A. Clayton, Southampton, and J. Riley, Birmingham—Firearms
898 T. Shakespear and G. Illston, Birmingham—Sewing machines
899 C. B. Parkinson, A. Metcalf, J. Metcalf, and W. H. Heald, Preston—Mules for spinning
900 F. Baker, Kennington—Railway point and signal levers
901 J. Woodhead, Bradford—Flooring cramps
902 W. J. Cunningham, New Oxford Street, and A. McCarthy, Broad Street—Obtaining motive power
903 E. Peyton, Birmingham—Rollers, cylinders, or tubes for printing upon textile fabrics

*25th March* 1869.

904 W. R. Lake, Chancery Lane—Folding paper.—A com.
905 J. J. Bodmer, Newport, Monmouth—Manufacture of iron and steel
906 F. Hurd, Rochdale, Lancaster—Excavating coal and other minerals
907 J. R. Baillie, Walthamstow—Wagons for carrying coal, coke, and other materials
908 J. H. Johnson, 47 Lincoln's Inn Fields—Manufacture of iron and steel.—A com.
909 T. Champion, Northampton—Flues or chimneys of houses and other buildings
910 J. T. Greenfield, Dover—Side-arm for clearing the chambers and rifling of ordnance
911 T. Baker, Brighton—Fire-escapes
912 W. C. Dreyer, Gresham Street—Tilling land.—A com.
913 J. T. Calow, Staveley, Derby—Cages or hoists used in mining
914 C. Marsden, Kingsland Road—Making gas and water-tight flexible joints to pipes and tubes
915 W. R. Lake, Chancery Lane—Pressing oil, tobacco, cotton, and other materials.—A com.
916 W. Meakin, Great Woodstock Street—Apparatus for raising, lowering, and securing sliding window-sashes
917 W. R. Lake, Chancery Lane—Electro-magnetic machine.—A com.
918 T. Sowden and J. Newton, Leeds—Bobbins and regulating the motion of bobbins in machinery
919 H. A. Bonneville, Piccadilly—Electric clock.—A com.

*27th March* 1869.

920 A. C. Kirk, Glasgow, N.B.—Cooling liquids
921 J. Mackintosh, Regent's Park—Working guns
922 H. Downie and I. B. Harris, Edinburgh—Shoes for horses
923 W. E. Gedge, Strand—Box for holding matches and other articles.—A com.
924 G. Dymond, Birmingham—Baking powder
925 L. Hannart, Clerkenwell—Muzzle for dogs
926 G. Hodgson, York, H. Bottomley, Low Moor, and E. Cockroft, Bradford—Looms.
927 J. J. Bagshawe, Sheffield, York—Manufacturing semolina and flour
928 N. Voice, Handcross, Sussex—Greenhouses and stretching wires for training plants
929 H. Haschke, Watling Street—Breech-loading firearms.—A com.
930 D. Jones, Birmingham—Buckets and pails
931 F. Parker, Leeds—Locomotive engines working on the "central rail" system
932 J. Jaquillard, Geneva—Musical boxes
933 B. J. B. Mills, Southampton Buildings—Extracting oleaginous matters.—A com.
934 J. W. Girdlestone, Norfolk Street, Strand—Constructing and treating vessels to correct and prevent compass deviations
935 E. H. Hirch, Brunswick, Germany—Storing and preserving meat and other articles of food on board ship
936 W. Riddell and T. Bletcher, Bishopsgate Street—Sewing machines

*29th March* 1869.

937 F. B. Taylor, Glasgow, N.B.—Numerical counting and recording machine
938 G. Bloem, Dusseldorf, Prussia, and Ernst Scheidt, New York, U.S.—Loading fire-arms and cartridges
939 W. R. Lake, Chancery Lane—Manufacture of soda and potash.—A com.
940 W. R. Lake, Chancery Lane—Blowing apparatus.—A com.
941 W. R. Lake, Chancery Lane—Horse-shoe nails.—A com.
942 E. Morewood, Briton Ferry, Glamorgan—Coating metals
943 S. Firth, Leeds, York—Picks and railways for cutting coal and other minerals
944 A. Clark, Rathbone Place—Stereoscopes.—A com.
945 W. P. Hope, Wouldham, Kent—Cement and other kilns

*30th March* 1869.

946 G. T. Bousfield, Brixton, Surrey—Sewing machines.—A com.
947 C. Weekes, Great George Street, Westminster—Combustion of wood and other fuel
948 J. Bath, King William Street—Telescopic pencil-cases
949 H. G. Dixon, Dundee, N.B.—Velocipedes
950 W. W. Harris, St. John's Wood—Velocipedes
951 A. Muir, Manchester—Velocipedes
952 M. McLeod, Edinburgh—Railways and the mode of working same
953 C. E. Brooman, Fleet Street—Balling or winding threads.—A com.
954 A. Barclay, Kilmarnock, N.B.—Steam generators
955 J. Briggs and J. Almond, Blackburn, Lancaster—Looms for weaving
956 T. E. Williams, Newport, Monmouth—Distilling hydrocarbon oils.—A com.
957 W. F. Proctor, Cheapside—Sewing-machine table.—A com.
958 F. Render, Manchester—Railways
959 T. G. Webb, Manchester—Furnaces for glass and melting pots
960 H. Y. D. Scott, Ealing, Middlesex—Lime and other kilns
961 W. E. Cadman, Holloway, Middlesex—Decorating surfaces

*31st March* 1869.

962 A. Chambers, Bow, Middlesex—Carriages or conveyances propelled by manual power
963 B. Dobson and J. Eastham, Bolton, Lancaster—Carding engines
964 F. W. Follows and J. Bate, Manchester.—Lawn-mowing machines
965 T. A. Dillon, Dublin—Utilising the waste steam of locomotive engines
966 T. Greenwood, Leeds, York, and John Keats, Leek, Stafford—Boots and shoes
967 A. F. Baird, Pimlico—Earth closets and urinals
968 R. Johnson, Waterloo Place, Pall Mall—Continuous bar or strained wire fences
969 G. Wells, Westminster—Separating copper and bismuth from ores.—A com.
970 J. H. Lloyd, M.D., Llangefni, Anglesey—Working, cutting, shaping, sawing, and hammering tools by power
971 H. Davey, John Street, Adelphi—Hydraulic machinery
972 W. Langer, Whitechapel Road—Manufacture of cigars
973 B. J. B. Mills, Southampton Buildings—Envelopes.—A com.
974 T. Corbett, Shrewsbury, Salop—Carts, waggons, and drays
975 B. Craven and H. Craven, Sheffield, and N. Craven, York—Brick and tile-pressing machine
976 J. Livesey, Westminster—Permanent way of railways
977 J. A. Hopkinson and J. Hopkinson, Huddersfield, York—Steam-engine indicators
978 R. Jones, Botolph Lane—Preservation of animal and vegetable substances
979 W. E. Gedge, Strand—Fastening belts by means of buckles.—A com.
980 J. B. Gridley, Fenchurch Street—Paper pulp.—A com.
981 T. Lippiatt, New Jersey, U.S.—Engraving and chasing metal

*1st April* 1869.

982 J. C. Lee, of Ashton-on-Mersey, Chester—Collecting excreta and the products of combustion emitted by chimneys
983 C. Lange, Strand—Winding mechanism of watches and clocks
984 H. Carter and G. H. Edwards, Bow—Breech-loading firearms
985 G. Holeroft and W. N. Dack—Steam-engines
986 J. Beckett and A. W. Field, Llandudno, Caernarvon—Break for railway carriages
987 E. O'Connell, Greenwich—Supplying nourishment to infants and invalids
988 J. B. Rowcliffe, Manchester—Manufacture of wire cloth
989 C. D. Norton, Old Street Road—Revolving boot and shoe heels and tips
990 T. Higgins, Maida Hill—Hats.—A com.
991 J. Caplin, Pentonville Road—Umbrellas and parasols
992 W. Gibson, Birmingham—Cramp-keys for breech-loading firearms
993 G. H. Wilson and G. E. Pullen, Commercial Road—Fastening window-sashes
994 W. Allan, Sunderland, Durham—Marine steam-engines
995 W. Bayne and O. E. MacGregor, Wolverhampton, Stafford—Carpenters' and joiners' planes

*2nd April* 1869.

996 G. H. Smith, Colchester, Essex—Cooking eggs and vegetables
997 J. Bath, King William Street—Printing and copying machine
998 H. A. Fleteher, Whitehaven—Improvements in steam generators
999 W. Marston, Loughborough, Leicester—Bolts
1000 F. Schäfer, Piccadilly—Covers and clip for bottles
1001 J. Cruttenden and T. Wells, Maidstone, Kent—Facilitating voting by ballot
1002 W. Y. Craig, Stoke-upon-Trent, Stafford, and S. P. Bidder, Mitcham, Surrey—Safety lamps
1003 D. Osborn, Great Berkhampstead, Hertford—Concrete building
1004 S. K. Hoxsie, Philadelphia, U.S.—Coal and grain elevators

*3rd April* 1869.

1005 G. H. Ellis, New Barnet, Hertford—Cleaning boots, shoes, and knives
1006 M. Wolfsky, Pilgrim Street, Ludgate Hill—Locks and fastenings for bags, satchels, and boxes
1007 R. Allan, Kelvindale, Lanark, N.B.—Manufacture of paper
1008 D. Nichol, Caledonian Road—Safe for food
1009 E. Wilson, Peckham—Velocipedes
1010 W. H. Douglas, Stourbridge, Worcester—Manufacture of jet ornaments
1011 J. Howden, Glasgow, N.B.—Preventing the escape of heat from the surfaces of cylinders, boilers, and other vessels containing heat
1012 U. Scott, Fitzroy Square—Railway and other carriages
1013 W. E. Broad, Wyehdon, Stafford—Loose railway wheels and axles .
1014 G. F. Griffin, Great George Street, Westminster—Railways and tramways
1015 D. J. Hoare, Princes Terrace, Bayswater—Atmospheric railways
1016 S. Sharrock, Liverpool—Construction of roofs
1017 F. Boyd, Boston, Massachusetts, U.S.—Breech-loading firearms.—A com.
1018 F. W. H. Medhurst, Chancery Lane—Lamps.—A com.
1019 J. G. Tongue, Chancery Lane—Parasols or umbrellas.—A com.

*5th April* 1869.

1020 G. A. Ermen, Eccles, Lancaster—Breech-loading firearms and cartridges
1021 W. Johnson, Swansea, Glamorganshire—Compressing carbonaceous, resinous, or other substances employed in the manufacture of fuel
1022 J. Woods, J. Hampson, L. Fish, and G. Fish, Preston, Lancaster—Looms for weaving
1023 J. U. Askham, Sheffield, York—Manufacture of anvils
1024 J. Fleteher, Heywood, Lancaster—Fire-bars
1025 F. Commasi, Paris—Obtaining motive power from flow of the sea
1026 W. G. White, Laurence Pountney Lane—Iron safes and strong-room doors
1027 W. Jones and T. Sheffield, Manchester—Boilers
1028 J. Winter, Wardour Street—Filling glass bottles and jars
1029 C. Cairns, New York, U.S.—Heating by steam
1030 J. W. Drummond, New York, U.S.—Looms
1031 J. Greenslade, Steeple, Essex—Traction engines
1032 J. Sterricker, Great Driffield, York—Expressing oils from seeds

## ON SOME POINTS OF PRACTICE IN IRON-FOUNDING.

### NO. XXXVI.

*Uniting cast iron to cast iron, by melting or "burning on."*

BEFORE proceeding to the immediate matter of the present paper, we return for a moment to that of our last article, and to a subject intermediate between that now to be treated of and the "casting on to" treated of in that article.

The manufacture of wrought-iron bedsteads has assumed almost gigantic proportions at Birmingham and its neighbourhood, and the improvement in the designs and style of those metallic bedsteads has kept pace with the extension of the trade.

As to the present day is still the case in Southern Italy, where iron bedsteads of great variety are made and have descended as a manufacture probably from even pre-Roman days, so in England, until comparatively recently, metallic bedsteads were either wholly of wrought-iron or of brass, or occasionally of the former material, united into scroll-work by bosses &c. of hard *lead* cast on round the rods of iron, to be by these united, and, as it were, to characterize them by a euphemism, ornamented.

For this lead, cast-iron has been latterly substituted, and no more advantageously applied instance can be given, of the method of "casting on" than this. Scroll-work to form the heads and foot panels of metallic bedsteads, of sometimes very beautiful designs, is produced by delicate curved or bent round rods of wrought-iron; to the conjugate parts of these rods, cast-iron chill-moulds are fitted, and in these are rapidly and sharply cast the bosses or *paterœ* or flowers &c. which are to unite the rods into a firm whole. That the cast-iron is *chilled* when thus cast does not matter, but for any special purpose the whole panel may be put into the annealing oven and the cast-iron brought to the state of "malleable cast-iron" without detriment to the wrought-iron rods which form it.

Nor has the skill of the founder ended here; by the process of "burning on," about to be treated of now, very elegant scrolls—Greek honeysuckle ornaments &c. are made to spring, as it were, from *one side* of the curved wrought-iron rods, and to adhere to these obstinately. In this case the moulds employed are of loam (themselves pressed into shape in metallic moulds and dried), so as not to cool the stream of very hot cast-iron which is poured through the little mould, and sweeping past the wrought-iron rod (of from ¼-in. to ½-in. diam.) speedily brings it up to a welding heat, and so enables it to solder itself, so to say, to the cast-iron ornament when that is set and cold.

Lightness, economy, beauty of form and of surface, when japanned, or painted and varnished, have been secured by these substitutions for the rude lead ornaments of byegone days.

There are several other matters in the manufacture of iron bedsteads of much interest to the metallurgist, one of which is the manufacture of thin *taper* wrought-iron and brass tubes and their application for uprights, &c., as well as the manufacture of brass tubing by rolling and drawing in forms of the most elaborate ornamentation; but these do not fall in the way of our present subject.

In numberless instances of ornamental cast-iron work the design involves enormous disparity in scantling between different parts of the same surface. Thus, for example, a *grille* may consist of very heavy vertical bars or members, and between these, for the whole or for parts of their height, there may be intercalated a light lace-like perforated or scrolled surface of extreme tenuity and delicacy.

An example of this may be seen in the elaborate, though not very handsome, *grille* in front of the Charing Cross Hotel (London), and a more ancient one in that of Apsley House and the gate of Hyde Park adjacent.

The designs and specifications for such works which emanate from architects, who in general know even rather less of iron-founding than they do of other constructional details, not infrequently require that such work shall be cast in lengths or panels, and that each of these shall be cast or run as one united piece. This is tacitly accepted by the founder, who, knowing the difficulty, sometimes the impossibility, of preserving sound during the cooling a casting such as this, accepts the work, with the mental reservation that he will really attach the fine thin and small work to the heavy parts *by one side only;* and so executes it. By this he secures, at least, that the whole shall not rend itself where weakest by the unequal contraction in cooling.

But the practice is bad in all respects. The same metal is not fit, at least is not best fit, for casting heavy and for light work. The light fine scroll work, if it is to be worthy of the founder's best developed art, should be cast of iron, too fine, soft, and fluid, ever to make the best of the heavy parts of the work, so that one or the other is certain to suffer. Besides this, with every device that even the most skilful moulder can adopt, the fine work will often fracture away from the heavy, even when confined to it by one side only. The true practice to adopt is, to cast the fine-work panels separate and previously, and provide these with small lugs at suitable points, cover these lugs with a coat of "clay and black wash," and lay into the sand mould as many as may be necessary of these panels, and then cast the heavy work around them. The fine work is perfectly secured in place, but yet both parts of the structure are free from mutual restraint both in cooling and for ever after.

As we have instanced the Charing Cross Hotel *grille*—which we presume to be from the design of Mr. E. M. Barry, architect, who has in some other instances evinced so just an appreciation of form in iron-work—it is but just to say that, so far as a passing view enables us to judge, we believe this plan of casting in the fine-work panels has been there adopted, whether by the specification, or without, or contrary to it.

The heavy members, if solids of revolution, especially of such *grilles* as that in front of the British Museum, may be cast hollow, the parts being "cored out." The extent to which this may be done with economy of material is not commonly recognised by the founder himself. We have known a *grille* designed in a sort of James I. style, with vertical bars not as large as those of the railing round St. Paul's Cathedral, London, all "cored out," and the metal not left anywhere more than three-eighths of an inch in thickness. In fact, this piece of boldness and ingenuity secured the work to the contractor; it was let by the yard, by a design only without any specification. All his competitors tendered for what the work might or might not be, solid cast-iron; he alone saved about one-half the total weight, at an insignificant expense for increased workmanship.

Before leaving the subject of iron railings or *grilles*, we may add one word as to the relative durability of cast-iron and of wrought-iron as materials for such in the air of our smoke-burning cities. Let any one contrast the state of almost perfect preservation in which the cast-iron uprights and horizontal members of the railing round St. Paul's presents itself, now after the lapse of about two hundred years, with the pitted and unequally corroded state of the old wrought-iron spikes on the top of the same, and he will at once see the superiority of the cast-iron as compared with the wrought. Here, however, it may be said, the wrought-iron has suffered from its neighbourhood with the cast-iron, and with the lead which is united with both. Whatever part the lead may have played—and that is no doubt a destructive one on both—the cast-iron can scarcely be preserved at the expense of the wrought-iron. The contrary is the conclusion indicated by R. Mallet's experiments (Brit. Ass. Reports) on the corrosion of iron, which showed that the harder metal was always electro-negative to the softer one.

But putting aside this, if the cast-iron bars of St. Paul's be compared with the wrought-iron uprights, &c. of some of the old *grilles* still to be found here and there about the old streets of London, built in Queen Anne's reign, it will be obvious how much more the more recent wrought-iron has suffered than the older cast-iron. In fact, the effect of corrosion of wrought-iron *grille*-work in our cities is destructive in two ways: first, by actual decay of metallic substance; secondly, by flakes and cakes of rust forming and accumulating, layer over layer, in corners and re-entering angles, and between closely opposed surfaces, which expanding as they oxidise more and more, on their way to black hæmatite—the ultimate form of rust, and that found in all very ancient air-rusted iron—forces or splits asunder the remaining parts of the structure.

It will be wisdom on the part of our architects, then—in our British cities, at least—to adhere to *grilles* so designed that they can be entirely fabricated of *cast*-iron, and to arrange for their connection with the stone or other bases upon which they are to stand without the aid of leading, if possible.

This last has been avoided in the low railings lately erected round the grass-plats opposite St. Margaret's Church, Westminster—but in a most unhappy manner, the mode of securing to the stone base being such that water and ice must necessarily get between the iron splay-feet of that very ugly railing, and gradually throw it out of line and level, if not out of the stone altogether.

Reverting now to the direct subject of the present paper.

Connecting lead with lead, by running a stream of very hot liquid lead, suitably confined, in contact with a surface of solid and cold lead, until the latter had got to its melting point, and then stopping the current, so that the two portions became united when both solid, has been known to plumbers for ages under the name of "burning together."

In fact, by this method some of the earliest lead water-pipes were made before "drawn pipe" was known. This same method of "burning together" may be also employed by the iron-founder, and occasionally with great advantage. The writer, in the course of his early practice, had occasion to cast four of the very ponderous columnar cast-iron frames which, in the earlier days of steam navigation, were to be employed for the "side frames" of side-lever marine engines of the heaviest class.

The frames in question consisted of coupled Roman-Doric columns of considerable diameter, cored out, with cross framing and entablatures, also all cored out, and with sundry projecting pieces like truncated horns &c., whereby the frames were to be united with other "thwartship" pieces, each frame weighing several tons and consuming a large amount of wages in moulding.

All four were cast sound and without a blemish, except that, upon the top box in which one of these was cast, all being cast in green sand, some one had unluckily dropped a bar or something heavy, or put a foot upon it, and produced "a crush," which rendered one of these horns utterly amorphous.

The casting, otherwise perfect, was in that state absolutely useless, and was about to be broken up, when the writer resolved to try and save it by attempting to "burn on" a new and perfect horn. The old and defective mass was carefully cut off, and removed down to absolutely sound metal. "Loam cakes," having the proper form for the horn, were taken from the pattern, the surface of the cut metal was well dusted over with powdered glass of borax, after that the mass of the "frame" in close propinquity with the defective place had been heated red-hot in a coke fire built up round it. The fire was then raked away, the loam cakes secured in place, and several hundred-weights of very hot liquid cast-iron were for some time kept flowing through the cavity of the loam cake hollow-mould. At length the flow was stopped, when the cut surface could be felt, with the point of an iron bar pushed through the running metal, to have become pasty and soft, and the iron was then permitted to set. When finally stripped and "gaits" &c. removed, the new horn was found to be perfectly united with the remainder of the casting, and when struck it gave the clear sonorous ring which proves complete metallic continuity.

The success, in fact, was perfect, and somewhat surprised both the writer, to whom so large an instance was new, and the marine engineer responsible for the supervision of the work, who would not pass the casting until he had assured himself of the safety of the horn by striking it heavily with a sledge-hammer. This method is capable of being applied not infrequently with similar ends in view, and may often save the condemnation of a casting and effect a good deal of economy. It can almost always be made effective, if the methods be judicious, for attaching, as in the above case, a heavy piece to a heavy casting; but it is a far more delicate and difficult task to make succeed with smaller and more delicate work, and there are two generic cases in which it is useless to attempt it.

One of these is where the form or dimensions, or both, of the casting must remain *precisely* the same after the work as before; as, for example, if a piece be defective in the rim or in one of the arms of a large spur or head gear-wheel, there would be no great difficulty in replacing it soundly by casting together as described; but either the wheel would crack somewhere on the setting of the "burnt-in" metal, or during its cooling, or it would have lost its circular form and "truth" when all should be cold.

Again, if the mass of casting be very great, and it is but a hole or cavity, regular or not, that requires to be filled in with metal, which must be perfectly united with the remainder, this can scarcely be accomplished unless at an expense that renders the process worthless; for *the whole* huge mass must be brought up to a strong red heat, with great expenditure of fuel and time and surface injury to it by oxidation, or the union will prove imperfect. Such has been the fate which has always attended attempts thus to restore defectively cast cylinders for hydraulic presses. The writer, however, has little doubt but that a sort of small coke-fed furnace, with a stroug blast, delivering from a small brick-lined mouth a jet of flame like that of a large blowpipe, might be so used as to heat even up to the melting point—and but very locally or partially—any mass of cast-iron, however huge, so as to admit of "burning on" to it. He once witnessed sufficient proof of this in the method taken to repair a defect which appeared in the neck of a very heavy cranked intermediate shaft for marine engines, at the Thames Iron Works, just before Mr. Mare ceased to direct them. The neck of the crank, about 18 inches diameter, was rough-turned, when a hole was found and cut into in the forging, close to the angle of the neck where joining with the arm or side of the cranked part. Nothing could be more awkward as to position, and the condemnation of the whole forging, and serious loss, seemed imminent. The foreman blacksmith determined upon one trial to save it. He got up just such a coke-fed giant blowpipe as has been described, and drove its flame right into the defect or cavity, having carefully "clayed up" the iron of the rest of the crank adjacent, to save it from oxidation.

In about five hours he had the interior of the cavity at a fine uniform and clear welding heat. A piece of wrought-iron, well-judged—as to form—to rather more than fill it, had been got ready, and at the right moment was brought, in a forge fire, to a welding heat also; and the blowpipe blast being thrown off, the welding hot plug, preceded by a dust of sand and borax glass, was thrust against the cavity, and a single blow of a "tup," beforehand properly swung ready, sufficed to firmly weld it into place. The superfluity, when cold, was chipped off, and the turning of the neck completed, which the writer witnessed; and he can testify that it was not possible upon the clean-cut surface then to discern where was the new iron, and where the surrounding old of the original forging. The work reflected much credit upon the skill of those who conducted it, and in that respect alone deserves to be recorded. The method of heating, however, is quite as applicable to cast as to wrought-iron.

The marine-engine framing above referred to was treated about 1833. In the *Annales des Mines* for 1860 M. Mengy gives a circumstantial account of the same method having been applied about the same date at the Tamaris Iron Works, Departément of Alais, to burning-on the broken-off necks of the iron rolls of the rolling mill, and with complete success. Dr. Percy ("Metallurgy," p. 745) states that he has seen a roll thus repaired at the Millwall Iron Works, and that the method has been in occasional use elsewhere.

Dr. Percy also gives an interesting account of the Chinese method of mending or stopping holes in their very thin cast-iron rice bowls or boilers, when broken through these brittle vessels, by means of a plug of pasty cast-iron adroitly applied by the native "tinker." He cleanses the edges of the hole, melts a sufficiently large bit of cast-iron in a small crucible in a little charcoal furnace, tilts the liquid iron out upon a folded damp cloth spread with ashes and held hollow in the hand, and at the moment before the cast-iron assumes the *pasty state* just before "setting," he thrusts it up to the outside of the hole and through it, and smoothes the overplus at the inside with another like cloth; so that he has thus made a sort of irregular rivet of the semiliquid material. There is here, however, no metallic union. The case is precisely analogous to the manipulation by which the plumber makes a "wiped joint," applying the semi-liquid plumbers' solder, held in the hollow of his "ticken-felt," rapidly and adroitly to and around, the shaved and tallowed surface of the adjacent ends of the lead pipe to be united; and equally analogous to the way that holes in earthenware vessels are sometimes mended in this country by a semi-liquid rivet of fusible metal quickly pushed through and smoothed over on both sides. It is not impossible but that more extended uses of this same method and of the analogous properties of cast-iron, though at its much higher temperature, might be found if looked after.

Where a mere cavernous defect exists in castings which injures appearance only, and which may be filled up level as sufficient remedy, cast-iron is very often dropped into the hole and the surface instantly scraped or cut off level by shoving an iron straight-edged scraper across the mouth of the now filled-up hole. This, however, is seldom a very neat method of repair, and some iron-founders adopt for the filling material an alloy which is almost identical in colour with the dark surface of freshly-made castings, but is much more fusible than cast-iron.

This alloy is said to be best composed as follows:—

| | | |
|---|---|---|
| Antimony | 65 | |
| Copper | 16 | |
| Lead | 13 | by weight. |

Some prefer—

| | | |
|---|---|---|
| Antimony | 69 | |
| Copper | 16 | |
| Tin | 2 | |
| Lead | 13 | by weight. |

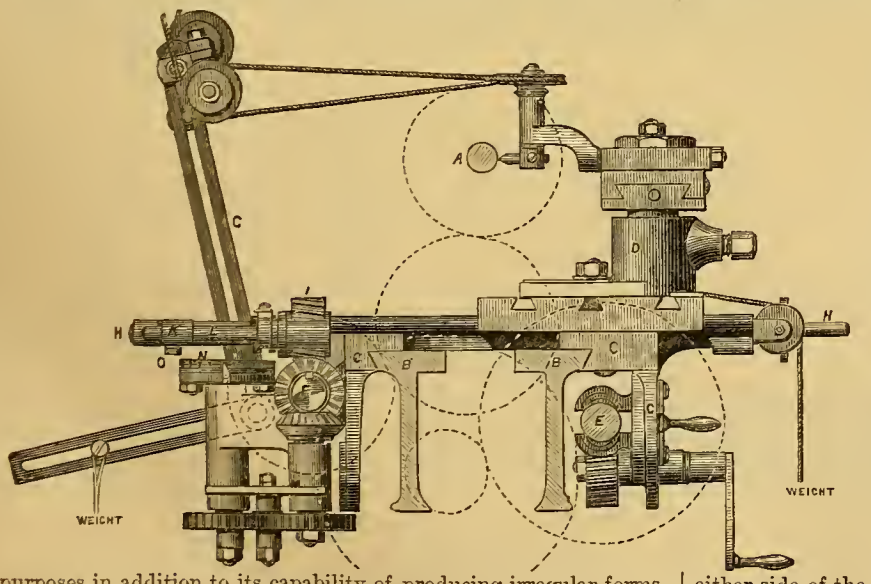
The copper, tin, and antimony are melted together first, and the lead then added.

Where, for such operations as are above referred to, defective or other parts of castings, more particularly of large size, require to be cut off, if there be suitable appliances at hand, they are much more easily removed at a cherry-red heat by means of a rapidly rotating circular saw, as in cutting off the ends of rolled iron rails, than by cutting away with machine tools or by hand, cold. Indeed, in many ways besides this, cast-iron is an extremely tractable material at a low or cherry-red heat. Thus, for example, at that temperature, castings which have been moulded flat may, if need be, be curved by bending over a saddle of suitable form and to almost any extent.

Or curved pieces, buckled in the cooling, may be forced back flat, or the curvature of pieces, which have too much departed from that of the model, by contraction in cooling, may have their curvature corrected, &c. The writer once cast a great number of very thin perforated flooring plates for a bridge, which were required to be curved into arch plates. They were cast quite flat, which, owing to peculiarities of form and perforation, was found the best plan to secure soundness, and then curved by bending over a saddle of baked fire-clay; for the saddle must not be of good conducting material, or the casting gets chilled and possibly broken.—Ed.

## TURNING IRREGULAR FORMS.

The subjoined illustration shows a peculiar form of slide rest designed by Mr. W. H. Northcott for turning articles of irregular sections. This system differs from the Blanshard and other lathes, inasmuch as it is applicable to ordinary slide and screw-cutting purposes in addition to its capability of producing irregular forms.




A is the line of lathe centres, B is the lathe bed which carries a pair of ordinary headstocks, C is the saddle of the slide rest caused to travel along the bed by means of the leading screw E. D is a restholder bolted to the surfacing slide, and is shown carrying an ordinary short slide with Willis's tool-holder and a light fly-cutter. This or other cutter is driven from overhead by a cord or gut which is kept strained in every position of the surfacing slide by means of the lever G. The shaft F and the leading screw E are driven from the lathe spindle by suitable change wheels, but generally the shaft F has to run at the same speed as the lathe spindle.

The surfacing slide carrying the restholder D is caused to move across the saddle by means of the screw H, either by a handle in front or automatically by the worm wheel I driven from a worm on the shaft F. The motion of the worm wheel I being communicated at will to the screw by means of a sliding clutch. The surfacing screw H is continued past the worm wheel and clutch, and at its end has a bearing with adjusting nuts, for running in the crosshead K, which crosshead slides on guides L, one on each side of the screw. The shaft F carries a small mitre wheel which rotates with the shaft, but by sliding along it is enabled to follow the saddle anywhere along the bed. This mitre wheel gears with a similar wheel below it on a short vertical spindle which has at its lower end a change wheel, one of a series any of which may be used to obtain the required speeds, and there is also another longer vertical spindle which rotates in a boss forming part of the same frame; this spindle also takes a change wheel and is driven either directly by the other, or through intermediates carried by the radial arm M. The top of the long spindle has a large collar or disc to which is fastened another disc or receiving plate N. The fastening is made by two bolts with T heads fitting a dovetail groove in the top plate and going through the collar below. The edge of one plate is graduated, and the other is furnished with a pointer, so that the top plate may be moved round any distance and there fastened by tightening the nuts below. The top plate has a number of screwed holes to allow of fastening various shaped plates to it. The sliding crosshead K carries a suitable rubber O placed just below the bearing of the screw H, and the shape of this rubber depends upon the shape of the copy plate.

The surface screw H has its usual bearing in the metal of the saddle, but the collars to the front bearing are formed by four nuts (shown dotted) which allow of any end play being taken up. The inside pair of nuts must, however, be screwed back when the irregular turning mechanism is in gear, as the screw H has then to slide lengthwise through its bearings.

On the lathe being started, the mitre wheel drives the short vertical spindle, and this motion is communicated by the change wheels to the copy plate attached to the top of the second vertical spindle. The shape plate in rotating, being pressed against by the rubber O, causes the crosshead K and screw H to slide endways, and this reciprocating motion is partaken of by the slide and tools carried by it. The rubber is kept in contact with the copy plate by a weight attached to the slide and passing over a small pulley in front, so that the surfacing slide may still be moved by turning the screw, and the pressure upon the copy plate is not affected by the position or movement of the slide. When using the mechanism the surfacing slide should be well oiled and made to slide freely, as then less weight will suffice to keep the rubber against the copy.

The shape of the copy plate is not difficult to determine, as any copy will either produce its counterpart or its inverted profile, according to the position of the tool's point relative to the centre of the work. The best plan for ascertaining the shapes of the plates is by means of a diagram of the motions.

With an excentric circle for the copy plate, a variety of forms can be produced; the excentric will produce an excentric with the tool's point either side of the lathe centre, but a slight alteration of its position will alter the figure.

Whatever figure the copy has been shaped to produce on a sur-

face, it is obvious that by moving the tool along the lathe bed in the usual manner a long shaft of the same section is produced, and this shaft can be made to taper just as in ordinary turning. In most of these applications of the mechanism, the copy and work make equal rotations, but in some cases it is more convenient for the copy plate to rotate 2, 3, 4, or more times to one of the work, as a simpler copy may then be used.

By having a very slight difference between the speeds of the copy and work, the latter is rendered spiral; that is, whatever shape its section may be, that shape continually changes its position. If the copy plate rotate faster than the work, the spiral is left-handed, if slower it will be right-handed. The pitch of the spiral will depend upon the relative speeds of copy, work, and tool—it will be the distance travelled by the tool whilst the fractional difference of the rotations has amounted to a whole rotation. These spiral forms are rendered tapering in the usual manner; and secondary spirals of any pitch can be cut upon them. The irregular shape mechanism is very usefully applied to turning cams, the cutting tools depending of course upon the shape of the cam, but as a rule revolving cutters are to be preferred, as they allow of a fast cutting speed with a slow speed of the lathe. Curved slots and grooves are also easily and automatically cut by means of this 'mechanism.'

It will be understood that when articles of irregular transverse section only have to be turned, the work and copy plate generally make equal rotations, and when the position of the section has to vary, there must be some slight difference between their speeds. By giving the copy a very slow motion compared with the work, the latter is turned circular, but its longitudinal section is irregular. For instance, by having a copy plate formed of a true spiral, tapering shafts are produced. Having an excentric circle for the copy, and rotating it very slowly compared with the work, the latter is turned circular, but it is longitudinally formed of a series of alternating internal and external curves. This shape is produced automatically, and may be rendered tapering, or a spiral of any pitch may be cut upon it, just as easily as upon a cylinder.

The practical applications of Mr. Northcott's mechanism are both useful and various. The curves of connecting rods are very easily formed by an excentric circle copy plate. The curved faces of belt pulleys can also be produced and given to one or to any number on the same shaft by the repeated rotations of a small excentric plate.

The drawing rollers of spinning machinery, handles of starting levers, bolts with countersunk heads, and many other articles frequently required in large numbers, can also be readily produced from suitably formed copy-plates; whilst for cabinet-making and for ornamental turning the applications of the mechanism are almost endless.

## ON INSTRUMENTS FOR INJECTING AND EJECTING FLUIDS AND LIQUIDS.

(*Continued from page* 36.)

(*Illustrated by Plate V.*)

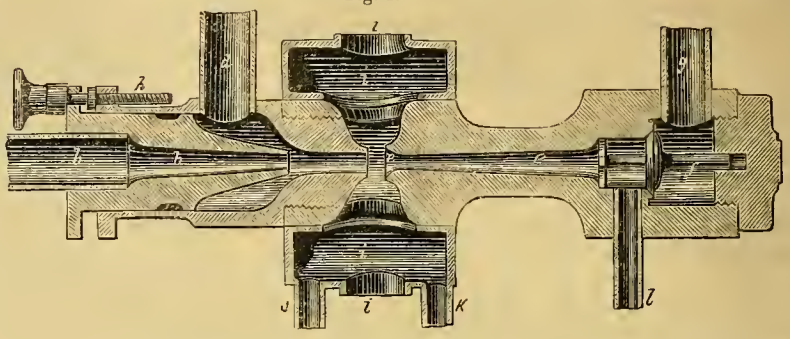
Our former paper was mainly occupied in setting forth the arrangements of apparatus for utilising the *attracting** and forcing action of one fluid or liquid, working through a nozzle or orifice, upon another fluid or liquid escaping through a contiguous, or, more strictly speaking, concentrice orifice, prior to Giffard's instrument of 1858. We also briefly put together the principles upon which the action of all such contrivances is based.

* The action referred to has not an exact verbal equivalent in the English language; and we use the verb *attract*, from the French *aspirer*, of which it is a literal translation, and more intelligible to readers of French technological works than to mere English readers only.

In the present paper our task is more important, namely, to record what was done during the year 1858, and has been effected onwards towards the present date, so far as the limits of a single Part of this Journal allow space for; reserving the carrying out of the plan now laid down to successive Parts, until we have, for all practical purposes, exhausted it.

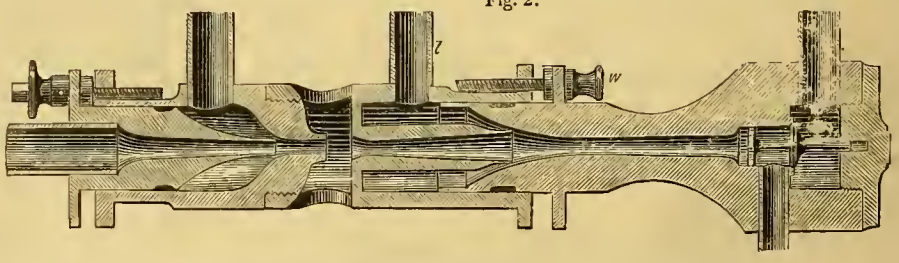
The first detail of our duty, then, involves the describing of

Fig. 1.



Giffard's instrument in its *original* state. Giffard's *original* instruments we now illustrate by woodcuts Figs. 1 and 2, in longitudinal section, showing their interior construction in both cases; something very different to what has been erroneously set forth as his "original." In fig. 1 the pipe *b* is that through which steam is supplied direct from the boiler; the pipe terminates in a contracted conical nozzle, and the steam, on escaping therefrom, impinges against the water, which is drawn in through the pipe *d* to the chamber surrounding the steam nozzle. The steam, in coming in contact with the water, is instantaneously condensed, but its energy and heat are imparted to the denser, and condensing fluid, so that a powerful rush of heated water (comprising both the water drawn in, as well as the water produced by the condensation of the steam) issues from the water nozzle, situate beyond the steam nozzle, into the throat *e*, at the extremity of which a valve *f* is fitted, the object of which is to prevent the return of water when the injector is not at work. From the chamber

Fig. 2.



containing the valve *f* the pipe *g* proceeds, communicating with the feed clack of the boiler; and another pipe *l*, fitted with a stopcock (not shown in the engraving) was also provided, to which a pressure gauge might be applied for the purpose of ascertaining the pressure with which the injected water was entering the boiler. A screw *h* is applied at one end of the instrument for the purpose of adjusting the position of the nozzle *b*, thereby regulating the area of opening around it, through which the water could flow, and consequently governing the amount of water passing through the instrument. Giffard enclosed the central part of his instrument by a box or casing *i*, in which little windows *i* were formed, and through these the rushing jet might be examined by the eye. The box *i* constituted also an overflow reservoir or chamber, into which any excess of water, or water which became diverged from the true jet and did not pass direct into the throat *e*, might escape; this sometimes happening on the starting of the instrument, and continuing until the position of the nozzle *b* (governing the flow of water) was adjusted in accordance with the quantity and pressure of steam passing through it. The chamber *i* was fitted with two pipes, J and K, the former communicating with the well or reservoir containing the water supply, so that any water arriving there might flow back to the source of supply; the latter turning upwards, and

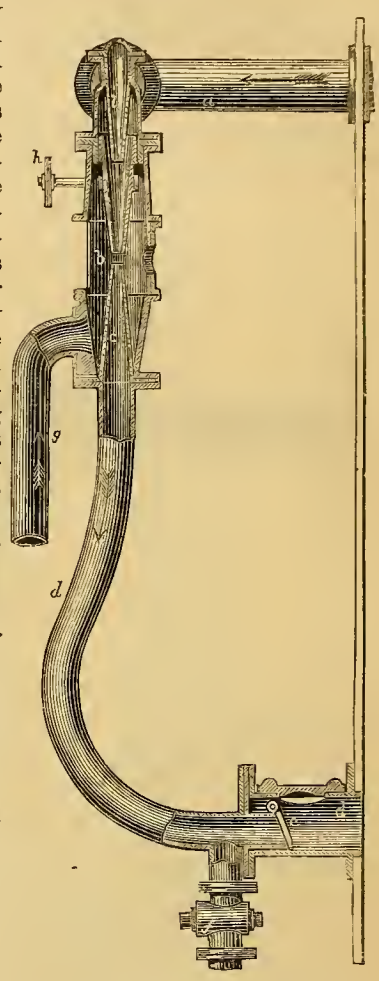
being for the purpose of allowing any uncondensed steam to escape into the atmosphere.

A modified form of this instrument is shown at fig. 2, and in regard to which Giffard has remarked as follows: "Below the atmospheric pressure water can condense steam only when its temperature is below 100° Centigrade=212° Fahrenheit. In case the initial temperature of the water in the hot well, or reservoir, or tender (when applied to locomotive engines), should be too high, which cannot always be avoided, to condense the entire quantity of steam issuing from the nozzle, it would be requisite to divide the actuating steam jet into two parts, as shown at fig. 2; the first portion acting as above described with reference to fig. 1, drawing up part of the water to be injected, and imparting to it only a fraction of the necessary speed, and the second portion arriving by the pipe *t*, and having its annular sectional form regulated by the screw w, would impart to the vein or jet a fresh impulse in the diverging mouthpiece." The impulse thus given to the water by the second portion of the steam renders the pressure or work, and velocity, in the jet superior to that originally in it prior to the first impulse of steam (it being understood that this form of instrument is only intended to be applied when steam of elevated pressure, or water of elevated temperature, is used); and the jet is therefore capable of carrying off and condensing the remaining steam arriving by the second passage *t*. There is some little difficulty at first sight in seeing through the effect of these successive actions; but it appears to us pretty clear that in this respect Giffard borrowed his ideas from Bourdon's *aspirateur à actions successives*, formerly described and illustrated by us at page 36.

In these earlier forms of Giffard's instrument are apparent (now that the conditions for the efficient action of such apparatus are better understood) several grave defects, which will make themselves evident as we describe subsequent arrangements by which the efficiency has been greatly enhanced. Several of these defects were soon discovered; and the first step taken to remove them was by Giffard himself, who, so far as we are able to find out, soon departed from the forms of boiler-feed injector to which we have before alluded. It was not until some time after that Giffard on the Continent, and Sharp, Stewart & Co. in England, had extensively applied the instrument as a boiler-feeder, and more especially as a substitute for the ordinary, but now nearly obsolete, feed-pump of locomotive engines; that other engineers pointed out its utility as a water-lifter or elevator; but the original instrument, we should judge, was very inefficient in this respect, for even the subsequent arrangement of Giffard's instrument—with which the writer had some practice in its very early days—was so inferior in lifting power that it could not draw water from a depth much, if anything, over three or four feet; indeed, unless most carefully handled, it would not lift from that shallow depth.

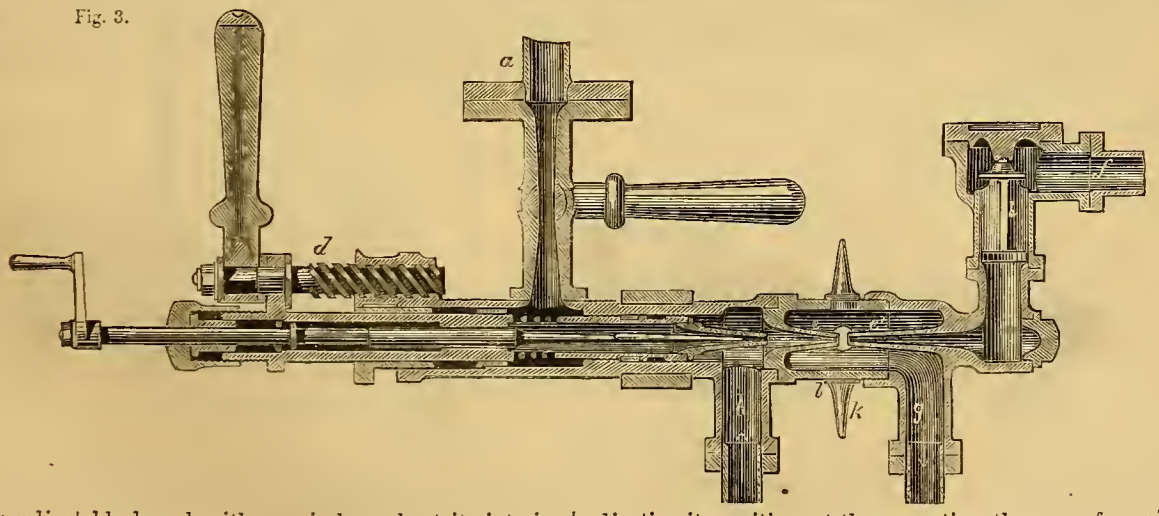
Giffard next arranged the injector as shown at fig. 3. The instrument in this case is composed of a cylindrical casing, which contains an adjustable barrel, with a conical nozzle at its interior extremity. Upon the outer casing a branch *a* is formed, through which steam is conducted into the instrument, the steam passing through the perforations formed in the inner tube, as shown in fig. 3; and passing down which, it escapes through the conical nozzle at its extremity. In the centre of the steam passage a spindle is situated, the position of which is adjusted by means of a screw formed on it; and a handle is affixed at its outer end, by which the attendant may regulate its position; thus at the same time diminishing or enlarging the area of orifice at the nozzle, as well as the volume of steam passing therethrough. The branch *b* is that through which the water arrives or is drawn in by the *attracting* action of the steam escaping by the steam nozzle, which impels it forward into the converging throat *e*, and from which it rushes into the diverging throat *e'*, the latter being so proportioned to enable the injected liquid to lose its velocity in the required ratio; after which, passing the intermediate valve *h*, it is forced along the feed-pipe *f* into the boiler.

Fig. 4.




Around the converging and diverging throats *e* and *e'* a chamber, called the overflow chamber, is formed, provided with an overflow pipe *g*, through which both water and steam escape when the instrument is acting imperfectly. Around this chamber eye-holes are formed, by looking into which the state of the injected stream could at any time be inspected; and around the chamber a metallic band *l* was placed, provided with little handles *k*, by applying the hand to which the band was rotated, and the inspecting-holes opened, for disclosing the stream to view or shutting it out of sight, as required. The pipe or band carrying the steam nozzle was provided with a regulating screw and handle *d*, for the purpose of adjusting its position, at the same time the area of opening for the flow of water. At this point, then, Giffard's invention, so far as

Fig. 3.

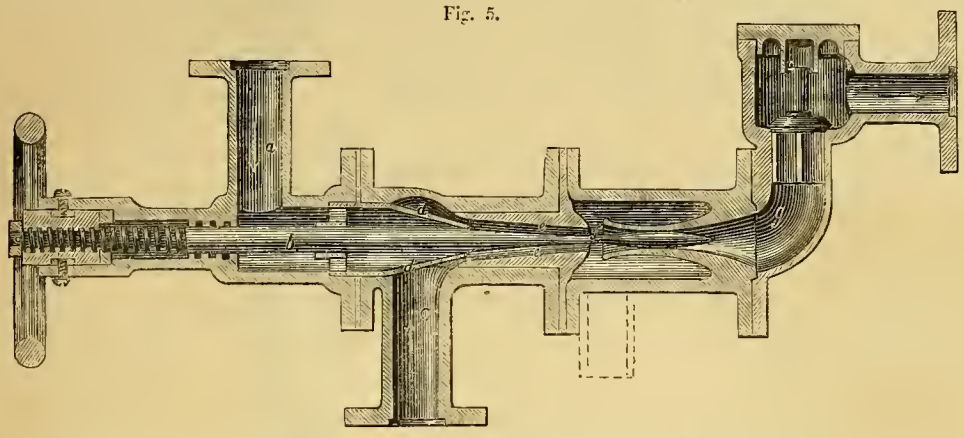


his own labours are concerned, appears to have terminated; but we must not omit to recognise how effectually he originated an opening for the display of subsequent improvements.

We next have to describe the apparatus of Mr. R. B. Longridge, of the Bedlington Engine Works, shown in longitudinal section at fig. 4. This apparatus has a different object in view from that of the injector as applied prior to 1861; Mr. Longridge then proposing to employ it for producing circulation of water in steam boilers, nevertheless that he subsequently employed it as a boiler-feeder.

This apparatus is composed of a tube *a* communicating with the water in the boiler, but excluded from communication with the steam. The water, being acted upon by the steam pressure in the

Fig. 5.



boiler, escapes through the pipe *a* with a moving force corresponding to the steam pressure. The pipe *a* communicates with the conical converging nozzle *b*, and the water escapes therefrom into the diverging nozzle *c*, thence through the pipe *d*, and, opening the valve *e* in its course, enters the lower part of the boiler. In this manner a constant circulation of water is maintained, the valve *e* being suspended as shown to prevent any counter-action against the rush of the jet downwards through the instrument.

On putting the apparatus into action, it is only necessary to open the cock *f*; this allows the water to escape for a moment into the atmosphere, and directly after it has thus begun to flow the cock *f* is again closed and the stream has sufficient momentum to open the valve *e*. The nozzle *b* and throat *c* are surrounded with a chamber having a pipe attached to it, which allows any water that may be dispersed to overflow. The nozzle *b* is formed with a worm-wheel around it, into the teeth of which a tangent screw, actuated by the hand-wheel *b*, works; so that, by turning the hand-wheel in either a right or left-hand direction, the nozzle *b* is either screwed further backwards or further forwards according to the adjustment required. Behind the nozzle *b*, and concentric with it, another nozzle *i* is situated, and through which steam can at any time be admitted by a separate steam pipe communicating with the steam space of the boiler.

About the same period that Longridge's apparatus was brought forward two Frenchmen, MM. Wahl and Pradel, effected some modifications in the injector. Their instrument is shown in longitudinal section at fig. 5. The steam nozzle *d* in this case is fixed, as well as the converging and diverging throats *e* and *f*, and the area of opening in each is regulated by the central spindle *b*. The shapes of the different parts in this instrument were so arranged as to ensure a constant area of steam-escape orifice in the nozzle *d*, a variable orifice for the passage of water in the converging throat *e*, and a variable or adjustable area of passage in the entrance to the diverging throat *f*, but a constant section of opening in the central part of the diverging throat. These different adjustments and constants are governed by the form of the lower part of the central spindle *b*, which is apparent on examining the engraving.

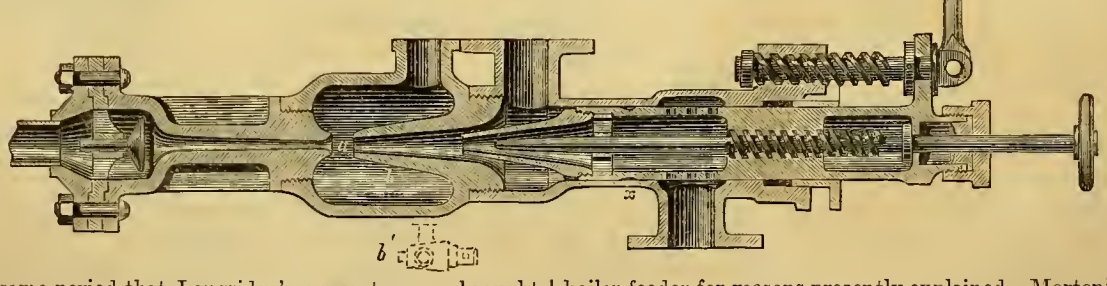
About the same period, 1861-62, the injector received further modification from the hands of Mr. Chase and others, but these were not of sufficient importance to merit our attention here.

In the early part of 1863 Messrs. Stewart and Robinson, of Sharp, Stewart & Co. of Manchester, made some minor improvements upon Giffard's instrument, which they were at that time manufacturing in large numbers. Their injector, embodying the chief of these improvements, is shown at fig. 6, and in regard to which they state in their patent specification (a portion of which we here quote, for it contains an important feature to which we shall hereafter have to refer) that "there are certain objections in using Giffard's injector, and by discoveries which we have made we are enabled to remove them; that is, we can stop the noise when working, prevent the admixture of air with the water passing through the injector, and the loss or waste of water escaping from the overflow cavity, and arrange so that the working of the apparatus can be brought more easily under the inspection of the driver or fireman in locomotive and other boilers; and, besides removing the objections, we can force cold or hot water at the overflow cavity." The cavity *b* is shown at fig. 6, which is a section of this improved injector surrounding the nozzles.

"This cavity is sufficiently large in most cases to contain all the water which may overflow for a moment at starting the injector, or which may arise from any slight irregularity of action in the injector, as the water which overflows at one moment will be sucked up immediately after. *The cavity may be entirely closed to the atmosphere when working*, but supplied with a jet-cock *b'*, shown in dotted line, so that a communication can be opened with the atmosphere when starting the injector."

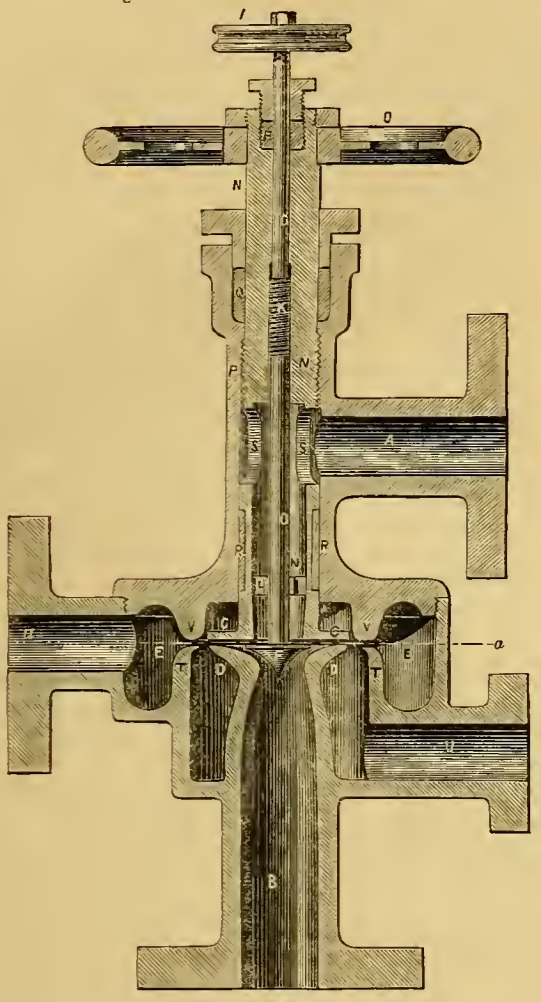
Further on in 1863 Mr. Alexander Morton, of Kilmarnock, devised an entirely different form of apparatus, namely, that which has since received the name of the *dise* injector. This instrument was originally designed as a *water-lifter*, as well as an instrument for feeding boilers. Yet, in the form which Mr. Morton gave it, it failed, we believe, to lift water more than 14 feet, and was unsuccessful as a boiler-feeder for reasons presently explained. Morton's instrument is shown in vertical section at fig. 7, and in transverse section on the line *a a*, fig. 7 at fig. 8. The chief features of the instrument consist in the employment of two flat annular surfaces C and D, situated at

Fig. 6.



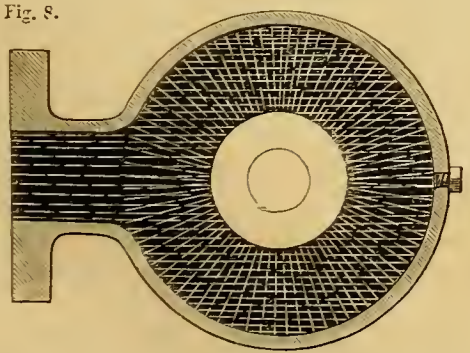
a certain distance apart; that one marked C is made in one piece, with a hollow spindle N, through which the spindle G passes, and it is worked by means of the hand-wheel I.

Fig. 7.




Another hand-wheel O is keyed on to the hollow spindle of the disc C, which, when turned round, varies the distance between the discs, through the intervention of the screw P. This hollow spindle, passing through a stuffing-box Q and having a groove filled with packing R, prevents any passage of steam outwardly, although admitting a free passage for the steam entering through the slots or holes shown at S. Within the discharge chamber and around the disc D an annular projection T, in connection with the overflow branch U, is cast and brought within a certain distance of another similar projection V, cast on the other half of the discharge chamber; so that a free opening all round

Fig. 8.

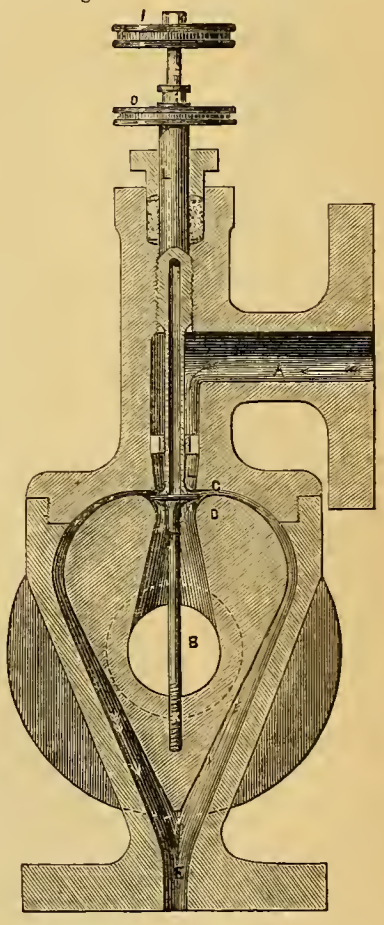


the periphery of the discs, and at some distance therefrom, receives the discharged water, which may be made to issue with great force by turning the hand-wheel I so as to admit more steam.

The causes of failure in this instrument are rendered clear by fig. 8, which shows by the dotted lines how, by the crossing of the directions of the currents of water all round the disc, the motion of one portion moving in one direction destroys and is destroyed by that of the other moving in a different or opposing direction. With this instrument there can be practically but little energy in the water, except in that portion which issues immediately opposite to the opening *a*, and this is insufficient for boiler-feeding.

The failure of the instrument as a boiler-feeder in the form now shown led Mr. Andrew Barclay, of Kilmarnock, to modify it into that shown in vertical section at fig. 9, by which the circular divergent sheet of water issuing from the disc was converged into a solid circular jet issuing from the orifice E. The instrument now last referred to, and illustrated by fig. 9, constituted Mr. Barclay's contribution to Barclay and Morton's joint patent of 1863; and, amongst other purposes to which it was intended to be applied, it is stated in the specification as being applicable for utilising the exhaust steam after it has performed its work in the cylinders of steam-engines or other steam machines, in which case the instrument is termed a "blow-through" condenser; for in point of fact, when so applied, it would condense the exhaust steam, and make a vacuum in the cylinder equivalent to that formed by an ordinary condenser from which the water and air are extracted by an air-pump.

Fig. 9.




As water elevators, these instruments of Barclay's and Morton's were superior to the Giffard injector as made at the time by Sharp, Stewart, & Co. The latter, as above stated, could with difficulty be made to lift water from a greater depth than 5 feet, whilst Morton's instrument brought it up about 14 feet.

We believe that to Mr. Morton belongs the suggestion of increasing the lifting power of the class of instruments we are considering, by causing the steam to escape in a thin sheet through or between two discs; thus enabling it to act over a much greater surface than obtains when escaping in a comparatively thick jet through the somewhat short and wide nozzles employed by Sharp, Stewart, & Co. prior to about 1865. Verbally, it is difficult to express the feature we allude to in exact terms; and as it is important that our readers should be well informed thereon—for on this the lifting and condensing efficiency of the instrument hangs—we give here the diagram, fig. 10, and the following reference to it:—

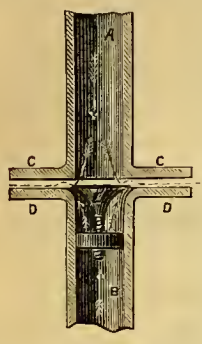
"The action of this apparatus will be better understood by referring to fig. 10. The actuating fluid, entering through A, impinges upon the disc E, and is then projected towards the periphery of the discs C and D, forming itself in its course into annular waves, increasing in diameter as they approach the periphery, similar to the motion shown on the surface of a disturbed lake, and represented by the dotted arrows, fig. 10. These waves between the discs C and D become as it were an air-tight fluid piston, which expels the air and forms a vacuum in the suction pipe B sufficient to raise water from any depth where an ordinary lift pump may be employed. If steam be the actuating fluid, and water the fluid acted upon, so soon as the vacuum is formed between the discs, which is only a few seconds, the water on meeting the steam con-

denses it, so that one steam wave striking beyond the annular opening around the conical piece E is sufficient to maintain the continued action of the apparatus, and the steam may be so far shut off as to diminish the space between the central piece E and the disc C, at the same time increasing the annular water space between it and the annular plate D, thereby admitting more water."

The action of Mr. Barclay's form of the "disc injector or ejector" is as follows :—

"The actuating fluid enters by the branch or duct A, and the fluid acted upon enters by the branch or duct B ; then both fluids unite between the two flat annular surfaces C and D within the discharge chamber E. The adjustable conical centre piece F is formed in one with its spindle G, which passes through a stuffing-box H, and on it is fixed a hand-wheel I, which serves to regulate the admission of the fluids through the intervention of a finely pitched screw K, chased upon the spindle itself, and working freely within a corresponding thread formed in one end of the apparatus. The actuating fluid, entering through A, impinges upon the base of the inverted conical piece F, and is then projected towards the periphery of the discs C and D, forming itself in its course into annular waves, increasing in diameter as they approach the periphery. These waves between the discs C and D become as it were an air-tight fluid piston, which expels the air and forms a vacuum in the suction-pipe B."

Fig. 10.

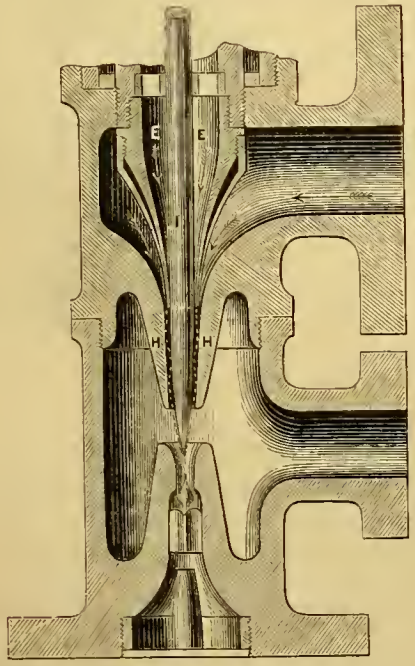



The experience gained with these last instruments led Mr. Barclay to devise the improvements in Giffard's injector shown at fig. 11. These improvements related in the first place to extending the annular nozzle used in instruments for injecting or ejecting liquids, through which the liquid passes, to *a much greater length* than had previously been used ; also in forming an *annular passage* beyond the first-mentioned nozzle for the purpose of obtaining an *annular sheet of steam* or water after the steam has passed through this nozzle.

The other part of the improvements related to the employment of the apparatus as condensers, and under which application the instrument is now designated an "ejector condenser."

On referring back to woodcut fig. 10, and now to woodcut fig. 11,

Fig. 11.




which represents the lower portion of one of Mr. Barclay's ejectors of 1864, and in which the extended steam nozzle E, and annular space formed in the water nozzle H by means of the extended length of the spindle I, are fully shown, it will be noticed on both of these figures that similar sets of dotted wave lines are shown ; in the former case the waves extending concentrically from the centre outwards, in the latter proceeding longitudinally down the extended annular space in the water nozzle. These lines, in fact, indicate that the instruments of 1864 were intended to do what those of the previous year were also intended for, but had failed to effect ; and in practice these latter instruments have shown the correct nature of their arrangements, having lifted and discharged the water from a depth of 25 to 28 feet.

But the more important of Mr. Barclay's instruments is that shown at figs. 1 and 2, plate 5 ; this, in fact, being the instrument which he originally designed as a steam-engine condenser—and of which a great deal has been heard of late—to be actuated by the exhaust steam from steam-engine cylinders.

The outer casing of the instrument has formed on it three branches A, A, and B. Immediately on the inside of this outer casing there is fitted the gland C, which presses upon the packing D ; this pressure being continued further on to the next ring of packing $D^1$ by the introduction of the slotted metallic collar E, the slots formed in which are for the purpose of enabling the fluid admitted through or at the branch A to be carried in towards the central part of the instrument. Beneath the second ring of packing $D^1$ there is placed another similarly formed metallic ring $E^1$, with slots also formed in it to enable the fluid to pass into the annular space F of the apparatus, and this in turn acts or presses upon the lowest ring of packing $D^2$, the several rings of packing D, $D^1$, and $D^2$ forming a suitable bed in which the barrel G is capable of sliding to be adjusted as may be required. Inside the barrel G is fitted the gland H, bearing upon the ring of packing I ; this again bears upon the slotted metallic ring J, below which is situated another ring of packing ; these two rings of packing form suitable beds, within which the barrel K, forming the inner annular space L, is capable of being adjusted, as before referred to with respect to the barrel G. Inside the barrel K there is situated the adjustable spindle M. The spindle M and the barrel K are actuated by the hand-wheel N and screws $N^1$ respectively. Both of the barrels G and K are mounted at their lower ends with nozzles *a* and *b*.

With this form of instrument it is obvious that there are three issuing orifices or nozzles, *a*, *b*, and *c*, as shown in both figures on the plate, so that the water and steam may be passed through the ejector in a variety of orders : either the water may pass at *a*, and steam through *b* and *c* ; or water at *b*, and steam through *a* and *c* ; or water at *c*, and steam through *a* and *b* ; or water through any two of the three nozzles *a*, *b*, and *c*, and steam through the third.

Mr. Barclay, some two or three years ago, instituted a series of experiments for the purpose of ascertaining the degree of vacuum this instrument would form : at first it gave a vacuum of 11lbs., but at the present time the instrument is so far perfected as to give a mean vacuum of 13lbs. on the square inch ; that is to say, a better vacuum than can be maintained constant by the most perfect air-pump yet applied to condensing engines ; while, at the same time, the first cost, and cost of maintenance and repair of the air-pump and ordinary condenser, are dispensed with, as well as the cost of working it, amounting alone (according to Rankine's recent statement) to about 4 per cent. of the indicated horse-power of the engines.

As this paper has already trespassed on a great extent of our space, we must reserve the continuation of the subject until next month. V. D.

(*To be continued.*)

## THE CANDLE MANUFACTURE OF THE PRESENT DAY. PRICE'S PATENT CANDLE WORKS, BATTERSEA.

### No. II.

In our last paper we described the breaking up of the crude Palm oil, under the joint influence of sulphuric acid, heat, and superheated steam, into constituents which ultimately assume the forms of stearine, a solid fat, and oil, or liquid fats ; and we pursued the separated stearine until we found it in the moulding-room, formed

into finished "stearine candles." We now proceed to the other various branches of manufacture within the cincture of these great works—all growing like branches from the parent trunk—from the before-described main process for the treatment of the main raw material employed. We say "main," because in several of these diverse secondary manufactures it is found advantageous and economical to employ, in certain proportion, other fatty materials—such as paraffine, vegetable waxes, other oils, and tallow, &c.

Of the stearine itself from the Palm oil it will be understood that, as the separation by pressure from the liquid oil, and the repeated meltings and coolings for purification proceed, there is a continued process of selection and separation going on, the stearine blocks becoming in the end classified into three or four qualities, of which the very best, and next, go to the candle manufacture, while some of the worst are reserved for application to other purposes, the chief of which is, in combination with other greases, to make soap.

A large proportion of the stearine of the better qualities is consumed in the production of a peculiar description of candle, viz., the well-known "night-lights," the manufacture of which in these works is conducted in a completely distinct factory, employing a great many hands, and amongst these a large detachment of young women and girls. A "night-light" consists of a card-paper case, very like a common card pill-box deprived of its lid. The bottom is also of card-paper, and through it is passed a short piece of cotton wick, previously stiffened by imbibition of liquefied stearine, the length being sufficient to rise above the top edge of the "pill-box," and admit of being lighted, after the box shall have been filled just full and even to its brim, with liquid stearine.

These are turned out in various sizes, to burn for various fixed periods—3, 6, 9, 12 hours, &c.—literally in millions; and labour-saving, by mechanical aids and labour division, are carried to a high degree of perfection in the busy hive where they are produced.

The manufacture commences with the production of the cases. The cardboard of these is formed of a stratum of fine pine-wood, between two surfaces of paper pasted to it. Large flat flitches of the very finest and most uniformly grained and knot-free yellow and white pine, prepared previously at the saw-mills, are placed on splint-cutting or splitting machinery. These are, in fact, gigantic power-driven carpenters' planes, which at each stroke made by the mass of timber, as it moves on the table to which it is secured beneath the fixed plane-iron, has a thin, uniform "shaving" of wood, of almost transparent thinness, taken off from its whole upper surface, and the precious shaving is safely deposited as one of a pile or layer. These are for certain purposes employed so thin, that 250 plies are required to make a pile of 1 inch in height.

These are cut into suitable sizes and forms by stamping-out machinery, whether they are to constitute the cases for the night-lights themselves, or, in thicker and stronger splints, are to be made into rectangular cardboard boxes in which the night-lights are to be packed for sale. In either case, the shaving of wood being first cut to about the right size, has both its surfaces covered with paper, pasted on. The cases of the night-lights are covered at one side—the inside only—with whitish paper, cut to exact size; and then the young women, wrapping these round cylindrical moulds, cover them with coloured papers on the outside, and by the same operation convert the flat surfaces into cylinders of nine or ten night-lights in length, and open at both ends.

These are stove-dried on their moulds; when dry, they pass to other girls, who work at specially constructed little light, fast-running lathes. Into these the mould-sticks, with their paper-tube jackets, are rapidly put, centering themselves instantly; and almost as instantaneously the girl cuts the revolving tube into as many short cylinders as its length suits, the division being performed by a short and peculiarly-shaped knife, guided as to the right lengths for the rings, by equidistant notches along a hard wood "rest."

The rings now easily slip off the moulds, and go to those who put in the bottoms, which, being of the same materials, are punched out like "gun-wads" from the paper-covered wood shavings, the central hole for the wick being made at the same operation. The short wicks are now put in, and by a simple but elegant contrivance secured upright and through the bottom. This is done by young boys. The empty cases, now complete, are arranged on trays (again in fixed numbers, so as to substitute counting for weighing), which run along after each other on to the benches, where the "fillers" find them under their hands, and make each little case brimful of liquid stearine. The stearine for this purpose is poured while below its temperature of most complete fluidity; it is about as thick as very thick cream or gruel, and is poured from tin vessels with long curved spouts, and shaped like large common oil-cans, nearly, the work being done wholly by hand.

Few examples of the dexterity acquired by practice are to be seen in any branch of manufacture more striking than that with which these men fill to the very brim, without spilling or overflowing one drop, which would spoil the appearance of the outside of one or of several night-lights, and pass over thus their trays of empty cases, with a rapidity that the eye cannot easily follow. It is the more remarkable, because there are not separate gangs of men to fill each different size of night-light, the size depending on the number of hours it is to burn; but the same man indifferently can fill, after a year or two's practice, cases of any size, and with equal rapidity and ease. The fillers — indeed, the workpeople throughout the whole factory—are paid "by the piece," and all earn good wages.

We have seen, in the course of a long observation or experience of manufactures of very various sorts, but one feat of dexterity, dependent on tact and practice together, which exceeds this of the "night-light fillers"—namely, that by which certain girls in the Lancashire cotton mills separate out from the huge can of sliver cotton, and in a moment tie up into a loose Lancashire knot, as much cotton as makes a hank for the spool in the next process; seizing instantly *precisely* as much cotton between her deft fingers as makes the right *weight* for the hank—with such accuracy that when an occasional hank is weighed as a check, none are found to differ from the others more than a minute fraction of an ounce. There seems, however, scarcely a limit to tactile adroitness; such at least was the thought suggested to most reflecting people who a year or two since saw an acrobat at the Amphitheatre, Holborn, amongst other feats, keep tossing from his hands and in the air together, a champagne bottle, an egg, a bit of paper rolled into a ball no bigger than a marble, and an iron shot weighing 30 or 40 pounds.

But to return. The filled cases now rejoice in the full glory of finished night-lights. They pass along to be cooled, and when quite solid as to contents, are packed up into the cardboard rectangular boxes, and go away to store. But of each lot one is selected by a superintendent. This is put into the inside of a glass case, in a dark room, freely ventilated, but kept from all draughts of air, and is there lighted, and its due performance as to time and manner of burning noted, before the whole lot is declared fit for service.

This proving-room might easily excite the worshipful feelings of a Parsee were he introduced to its "dim religious light," and see, in the long mysterious-looking glass shrine, some hundreds of dim little taper flames, the source of which is scarcely visible.

The rectangular boxes, we should have mentioned, after their constituent cardboards have been covered inside, and cut to shape by stamping machinery, have the wood splint at each right angle of the future parallelogram cut about half through by a highly ingenious knife machine, so as to prevent splitting of the wood grain in turning up the sides, and after these are made up into bundles of 100 each, are given out to the women and girls employed, and are by them made into the boxes, and covered with the outside coloured papers and printed labels, by pasting these on, at home.

This affords a clean, wholesome, and valued source of domestic employment to these women and girls, or to others of their families in after hours.

The great mass of the coloured papers and labels used in this and in various other branches of the manufactory, are purchased. Their number and variety are so immense that the total demand would be enough to keep a large coloured and ornamental paper manufactory, and a very large printing establishment, at constant work. So it is found best to contract for the main and less changeable portions of both these.

But, in smaller quantity, labels of unusual or of temporary sorts are continually being needed; and to supply such, as well as,

for a measure of safety, to prevent the possibility of stoppage by failure of external supply, there exists, as a separate department, a by no means insignificant establishment, for the colouring, embossing, and ornamenting of the cover-papers, and for the printing and production of the labels ; those for the finer sorts of candles and soaps being often printed in gold or bronze powders, or otherwise of a very elaborate decorative character.

In the end, both candles and night-lights—and with the soaps, it is the same—go into store in lettered and numbered boxes, which are so arranged that any one sort can be instantly got at.

These stores are huge iron-roofed brick one-story sheds, with flagged floors, and lighted from the roof, and with some special precautions as to temperature, and present the character of arsenal stores almost in magnitude and beauty of arrangement. Of course only work not intended for immediate sale is so stored ; all "order work" goes into distinct stores. In all these stock stores there are stock-books, in the charge of the foreman of the store, and he discharges himself of each delivery made, by printed and filled-in orders from the central office, which he files—just as we before described to be the practice—in the "current order" stores.

We may now pass away to the Soap works, where palm oil, stearine—of the inferior sorts—tallow, and various fats are made into curd soap.

The caustic alkali and melted fats re-act upon each other to produce saponification in large iron boilers, heated by fire, or by superheated steam passing through a coiled pipe in the bottom of the "copper," as the iron boiler is still called, historically pointing to the material of which these were originally made.

As the manufacture of curd soap or "white soap," as well as "yellow soap" or "brown soap," into which rosin enters and gives the colour, is tolerably well known, we need not here go through details. Yellow soap is formed of palm oil and tallow, or, in other works, of London grease, often without any rosin.

After the soap has been formed, and the "negur" or deposit at the bottom, and the "fob" or frothy top have been separated, the pure soap, which has been "crutched"—*i.e.* stirred up powerfully with large crutch-ended poles, to break up the semi-crystalline grain and make it homogeneous in texture, is ladled out into the "frames."

These are large rectangular moulds of cast-iron, with moveable sides, and when the soap is quite "set" and cold in these, and the iron sides are removed, there stands at the place of each a rectangular prism of soap of about 6½ feet high, in thickness the length of "a bar of soap" of commerce, and weighing just three-quarters of a ton.

Glycerine is one of the educts of soap-making, and what is here produced goes to its own department of the work which deals with that material, of which more anon.

This huge prism of soap is now cut into slices in equidistant horizontal planes, by means of a stretched and guided steel wire, about the size of one of the treble strings of a pianoforte. These slabs are removed and again cross-cut in the same way, and now are reduced to square prisms or "bars" of white soap or brown soap, as it may be, of about 2½ inches square, and of the usual length.

These are sent out for local or London consumption in open-topped strong ironbound square bucket-like cases. Those for stock or for export are packed in suitable sized boxes.

For the manufacture of these boxes there is a distinct part of the establishment, in which all the usual wood-converting machinery is found at work, the rough timber in log being barged up the river from the Commercial Docks or other depôts. Subsidiary to the great Soap works is the manufactory for "fancy" and "perfumed" soaps. These are all made from the best curd soap, cut into shreds, passed between kneading rollers, and pressed into cakes, after having been variously coloured and scented. These finally find their resting-places in more or less gorgeously ornamented cardboard or other larger boxes, the manufacture of which are parts of the duties devolving upon the box and packing-case factories, which we have already described.

In the cardboard box factory, where women and girls are employed—being the only department of the works in which they are so—there is a separate entrance and exit for them, and complete isolation from the boys and men while at work.

On the occasion of our own visit it was very pleasant to observe the clean, well-clad, and orderly, modest appearance of all these girls, who work under a forewoman or matron—a vast improvement over the foreman system of the cotton and woollen districts—where an immoral and licentious foreman has, by the very nature of things, almost absolute power over the women, if he chooses so to pervert his office.

And here we may just mention that Price's Candle Company, or rather its managers, subscribe largely to the schools in their immediate locality ; have evening schools at the works ; a fine roomy dining-room, where any one in the employment is free to dine and to get his food—dinner of tolerably various sorts, if he choose—from the adjoining man-cook and kitchen, and at prices which show what capital and co-operation, rightly and benevolently wielded, can do in the way of economising the wages of the worker. Generally order, harmony, and social comfort and improvement are promoted amongst all the people employed. These really amount to a little army ; if we take home and factory operatives together, there are, we believe, about 700 hands in the works, and at least 2,500 dependent on these for their daily bread.

We must now go back to the press and the still-houses, where, in our last article, we left off, to pursue the stearine. The liquid fat expressed from the solid stearine is again pumped up into stills, distilled with superheated steam, and broken up into oleic acid and glycerine.

These are also, like the stearine, subjected to fractional distillation, and by selection, separated into various qualities, and then applied to various uses.

The fine liquid oil or *olein*, thinned or thickened as may be required by admixture with other oils or fatty materials, is used for burning in lamps and as an unguent. The coarser becomes a material for soap, and for railway grease and divers other applications. Mr. Jas. Young's paraffine oil, in its purity, is too thin a fluid to use as an unguent alone, except for some special purposes ; mixed with these oils from palm oil, it becomes of widely extended use for oiling machinery &c. As one indication of the care and skill with which everything is done here, there is a room in this part of the works in which are several of the most improved mechanical oil-testers, *i.e.* machines to indicate the lubricating power of any given unguent. By these every oil sent out in quantity is tested, and the result registered, so that another order for oil of like properties as to lubrication can be with certainty supplied.

These oil-testing machines, however, leave a good deal to be desired even yet, and can scarcely be depended upon to afford *absolutely* concordant results over any long period of working. Surfaces of polished agate would probably be much better, as less subject to change than surfaces of gun-metal and of steel for rubbing together with the oil between; for these metallic surfaces, as one or both abrade more or less, are really never the same for two successive revolutions. What is wanted also is a self-registering oil-tester, which should give in figures not only the lubricative power of the unguent at the first moment of use, but the rate of its deterioration in use, *i.e.* not only the goodness, but the durability of the unguent : such a machine would well reward the inventor who rendered it accurate and trustworthy.

The glycerine, separated into various qualities, is again, some of it, distilled, and the very best constitutes the well-known Belmont Glycerine, now so largely consumed in surgery, pharmacy, and perfumery. It also goes, or did go, to Hamburg to be made into nitro-glycerine, the notorious and formidable explosive agent; and is consumed more or less in a great variety of manufactures and for many purposes, chiefly having in view the delaying or preventing drying or desiccation.

Thus it has recently been introduced as one element of the greasy and gummy dressing put upon hemp and flax yarns, and is, we believe, esteemed in these a great improvement by the yarn merchants of the North of Ireland. The writer had some years ago information, which he believes quite authentic and trustworthy, that the original suggestion of the use of glycerine as a pharmaceutical agent was due to the late Mr. Eneas Coffee, the inventor of the well-known Coffee's Spirit-Distilling Apparatus. When advanced in years he was afflicted with some dry cutaneous disease of the face, and finding great relief from preserving the skin moist

and flexible, and knowing from his connection with chemical manufactures the properties of glycerine, he thought he would try it on his face—the result being present relief and final cure.

Glycerine then, however, was far from pure; now it is sent out from the Belmont Works nearly absolutely pure, and almost free from water.

The whole of the machinery in these great works is driven by a pair of coupled Woolf's or double-cylindered beam-engines, having a combined power of little short of 100 H.-P., judging by size and eye only. The boilers for these, as well as all those for producing the superheated steam used in such volumes in all directions, are all furnished with Jukes' Self-Feeding Furnaces—burn nothing but small coal, costing 8*s*. to 11*s*. per ton in the works, and do not appear to produce any sensible smoke.

As adjuncts to the works, and to keep them and their legion of machinery and apparatus in order, there are a moderate-sized engineer's shop, well supplied with heavy and light tools of all sorts, a pattern-maker's shop, drawing offices, stock store for engineering materials, and spare stores and machinery; a brass foundry, a coppersmith's shop, a plumber's shop, a painting shop; large stabling; and an establishment of barges and bargees upon the river, with quite a field-train of delivering vans for London and its suburbs.

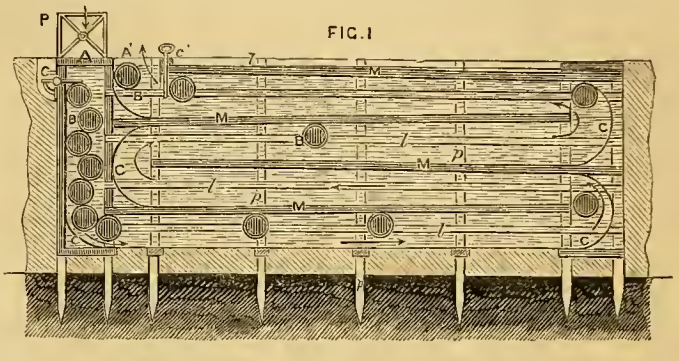
In this vast establishment, and without reference to the other concern worked by the same Limited Liability Company at Liverpool, about 20,000 tons of palm oil alone are worked into saleable form per annum, exclusive of any other of the fatty materials to which we have alluded. There is a commodious experimental chemical laboratory placed centrally in the works, in which everything, to the instructed eye, points to its exclusive dedication to the chemistry of the fats.—Ed.

## STORING PETROLEUM.

Various modes of more or less merit have from time to time been proposed of storing petroleum, with a view of protecting this dangerous material from fire, but none has fulfilled all the required conditions. As the subject is one of high importance, from the terrible results which attend an accident and the too frequent recurrence of such disasters, probably the following description of two recent inventions, having for their object increased safety in the storage of petroleum, will interest many of our readers.

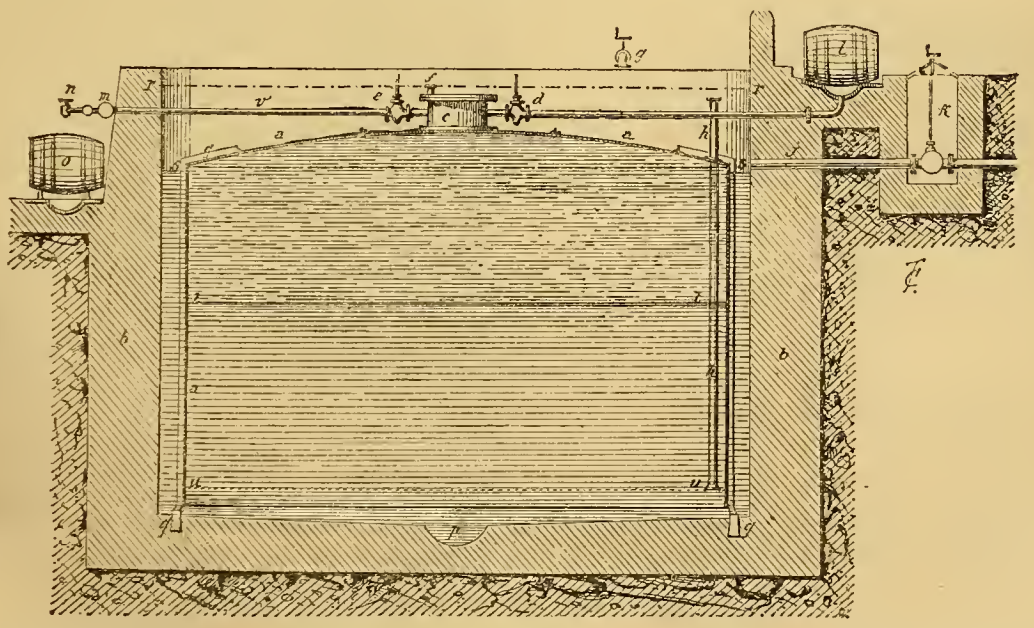
The accompanying figure is a sectional elevation of an apparatus for this purpose, designed by Mr. J. Mathei, Merchant, of Anvers, Belgium. Mr. Mathei proposes to immerse the casks containing the oil in basins or reservoirs of water, and he has devised means for facilitating the introduction of the casks to the tank and the withdrawal therefrom. Within a tank of suitable depth and capacity piles *p* fig. 1 are driven fast into the ground, and arranged in such manner as to admit of the passage of the casks B in its longitudinal direction. At one end of the tank a species of well A is formed for the introduction of the casks B. To these piles are attached, by means of cross-pieces, joists M, which form a series of inclined

FIG. 1




planes. The inclination of these planes is varied according to the density of the oil and their distance apart, in proportion to the size of the casks. Longitudinal rods *l* are attached to the piles to act as lateral guides for the casks. Doors P are provided to close the inlet and exit passages, and these doors when open form a continuation of the well A. The casks are inserted the one on top of the other, so as to sink them to the bottom of the well A when they traverse the length of the lower inclined plane; and on reaching the end, by reason of the difference of the densities of the oil and the water, they ascend and turn the corner C, and following the direction of the arrows they continue their progress until they arrive at the outlet, where their motion is arrested by a stop *c*. This operation continues until the magazine is completely filled. The casks in the well A are prevented from rising by the apparatus *c*. The joists M may, if necessary, be made moveable, so as to adjust them to any required inclination, and walls may be substituted for piles. The casks may be readily removed when required. Mr. Ckiandi, Engineer, of Marseilles, has introduced a system of reservoir for petroleum, which, after having been submitted to a practical test, has proved superior to others.

Fig. 2.




The arrangement of his apparatus is shown in vertical section at fig. 2. The reservoir is composed of a square receiver *a* of sheet iron, open at the bottom, and closed at top by a convex cover. This receiver is firmly secured by trussing *q* in a cistern *b*, the walls of

which are carried up to a sufficient height above the top of the receiver, so that the latter may be covered with a large quantity of water. *c* is a man-hole, connected with which are two pipes *d e*, the former of which serves to fill the reservoir, and communicates with the cast-iron trough where the casks *l* are emptied of their contents. The pipe *e*, which is intended for emptying the reservoir, is provided with a cross-pipe *m* and a series of cocks *n* for filling the casks *o* with the oil so withdrawn; *f* is an air-hole on the man-hole *c* for the escape of any air contained in the receiver, and which may also be used as a level-indicator or guage by the application thereto of any suitable apparatus; *h* is a tube provided to indicate when the receiver is full.

The apparatus operates in the following manner. The cistern is filled with water, say to the level *r* through the cock *g*, and the receiver *a* and the pipe *h* will also be full. The air-hole *f* and the cock *g* being then closed, the cock *k* is opened. The water will then run off until the level is reduced, say to *s*, when the cock *d* is opened, and oil emptied from the casks and supplied to the receiver; the oil so introduced displacing an equal volume of water, which escapes through the pipe *j*. In the engraving the receiver is shown half full of oil, the water level being at *t*, the level of the water in the cistern and in the tube *h* being at *s*. If the supply of oil is continued, the level of the water will become so reduced in the receiver that oil will enter and ascend the tube *h* and, by means of an alarm with which that tube is provided, give notice that the reservoir has received its maximum charge. The tube *h* and cocks *k* and *d* are then closed, and the cistern is refilled with water to the level *r*, so that the receiver and all its appurtenances are entirely submerged.

When the oil is required to be withdrawn, the pressure of the column of water facilitates its discharge, the cock *g* being open so as to maintain a supply of water proportionate to the volume of oil drawn off.

The characteristic feature of Mr. Ckiandi's invention consists in precluding the possibility of void spaces occurring above the petroleum, which have a tendency to produce explosive mixtures. In this he has been perfectly successful, and we understand that some most favourable reports have been made of the working of his apparatus.

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## RECENT PATENTS.

### MANUFACTURE OF IRON AND STEEL.

JOHN HENRY JOHNSON, 47 *Lincoln's Inn Fields*; *a Communication from* AUGUSTE PONSARD *and* F. E. BOYENVAL, *Paris.—Patent dated January* 22, 1868.

THIS invention relates to a peculiar process and furnace for manufacturing cast and wrought-iron and steel, whereby the costly blast-furnaces hitherto employed are entirely dispensed with. The furnace employed is constructed somewhat similar to a reverberatory furnace, with a double sloping hearth for the collection of the molten metal. The hearth is heated, either by an ordinary fire-place or furnace, or by gas, in which latter case a Siemens or other like apparatus well known to metallurgists would be employed.

Fig. 1 of the accompanying drawings is a longitudinal vertical section taken along the line A B (figs. 2 and 3) of the furnace; fig. 2 a horizontal section taken along the line E F (fig. 1); and fig. 3 a transverse section taken along the line C D (fig. 1).

A is a furnace somewhat similar to a reverberatory furnace, in which are placed tubes B of refractory clay, which the patentee

FIG. 1.

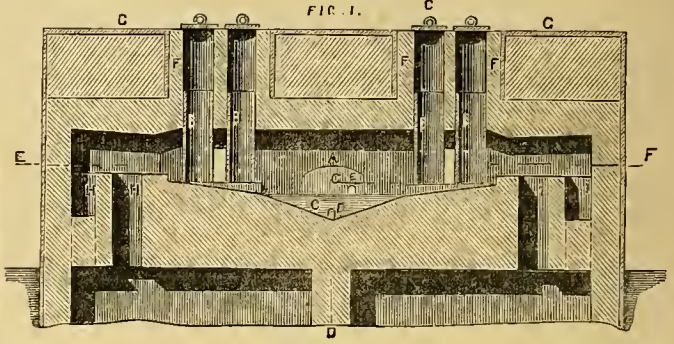
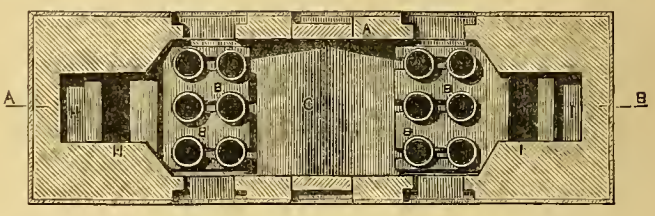
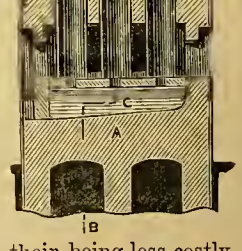



FIG. 2.




designates crucible-tubes. These tubes are disposed vertically in the interior of the furnace, their upper ends entering the roof, whilst their lower extremities rest on the inclined hearth of the furnace, in such a manner, however, as to admit of the molten metal flowing freely over the hearth into the central basin C, where it collects, and from whence it is withdrawn through the tap-holes D formed in the sides of the furnace. The apertures E placed above the tap-holes are provided for the purpose of removing the slag and cleaning off the dirt. The crucible-tubes B, which enter the roof of the furnace, are continued to a certain height by brickwork F of refractory bricks or fire-clay, at the level of which there is laid down a flooring G of cast-iron for the workmen employed to charge the crucible-tubes B, the apertures of the prolonged portions of such tubes being situate on the flooring G. These apertures are provided with lids or covers, which serve to cover them after each successive charge. The furnace is heated by gas, by means of a special apparatus, such as that of Siemens or other system. The gas and air are introduced at the extremities of the furnace through the flues H, and the products of combustion escape through the apertures I, after circulating or playing round the crucible-tubes, which the ignited current of air and gas is intended to raise to an elevated temperature, in order to produce the fusion of the ore contained in such tubes. These crucible-tubes may be of a round, rectangular, or elliptic section, and any required number may be used, and they may be of any suitable dimensions. They are in fact crucibles without bottoms, so that crucibles placed in the same conditions, and with the bottom perforated with one or more holes in order to allow the melted metal to run out, would give precisely the same results, and the tubes are only preferred on account of their being less costly. This furnace may be heated by a fire direct, like the majority of reverberatory and puddling furnaces.

Fig. 3.




In order to manufacture cast-iron, iron ore previously calcined and suitably crushed is introduced into the crucible-tubes B, and the requisite quantity of flux is added, consisting of either lime, clay, or silica, according to circumstances, each charge of ore being

# BARCLAY'S "EJECTOR-CONDENSER" OF 1864.



Fig. 1.

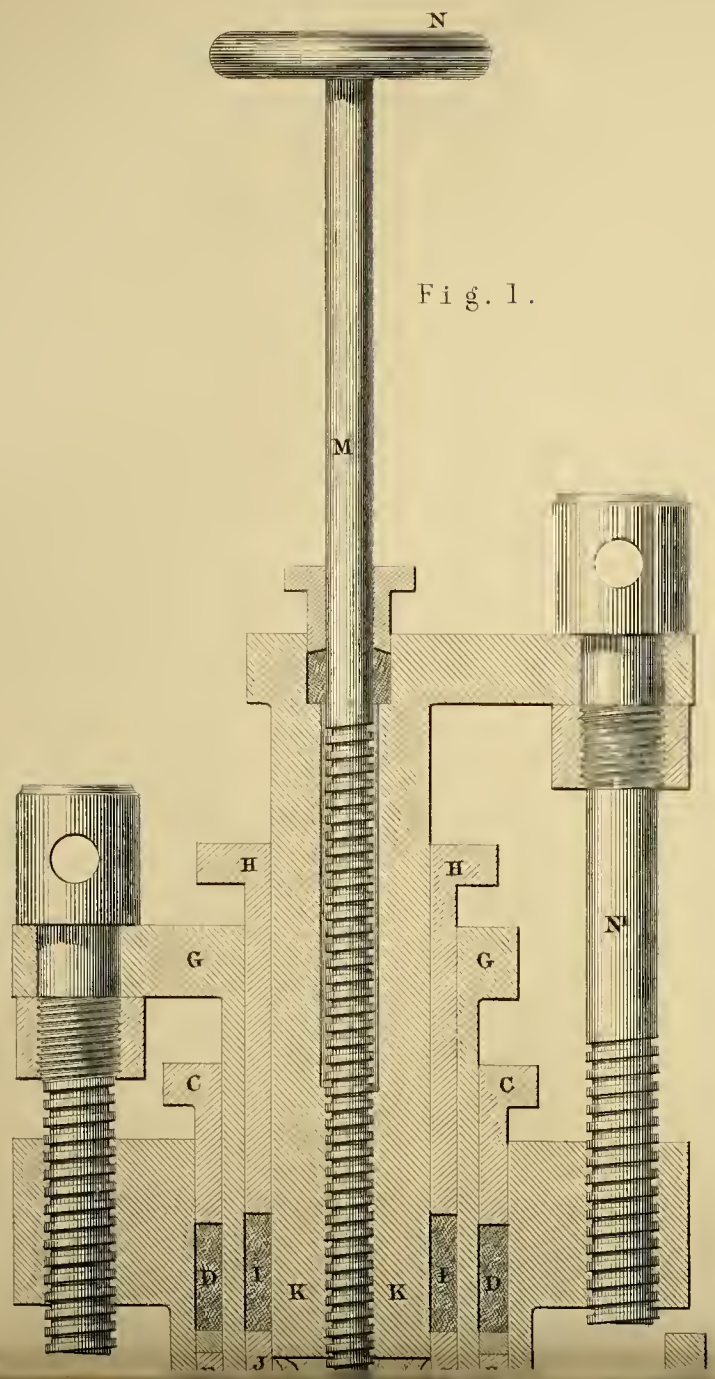
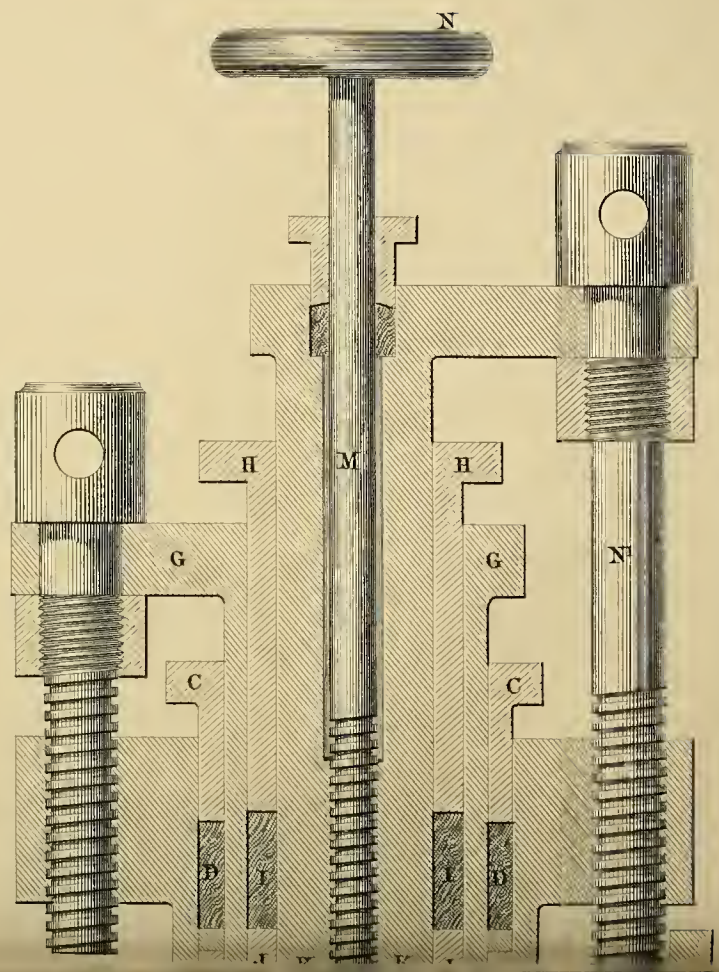
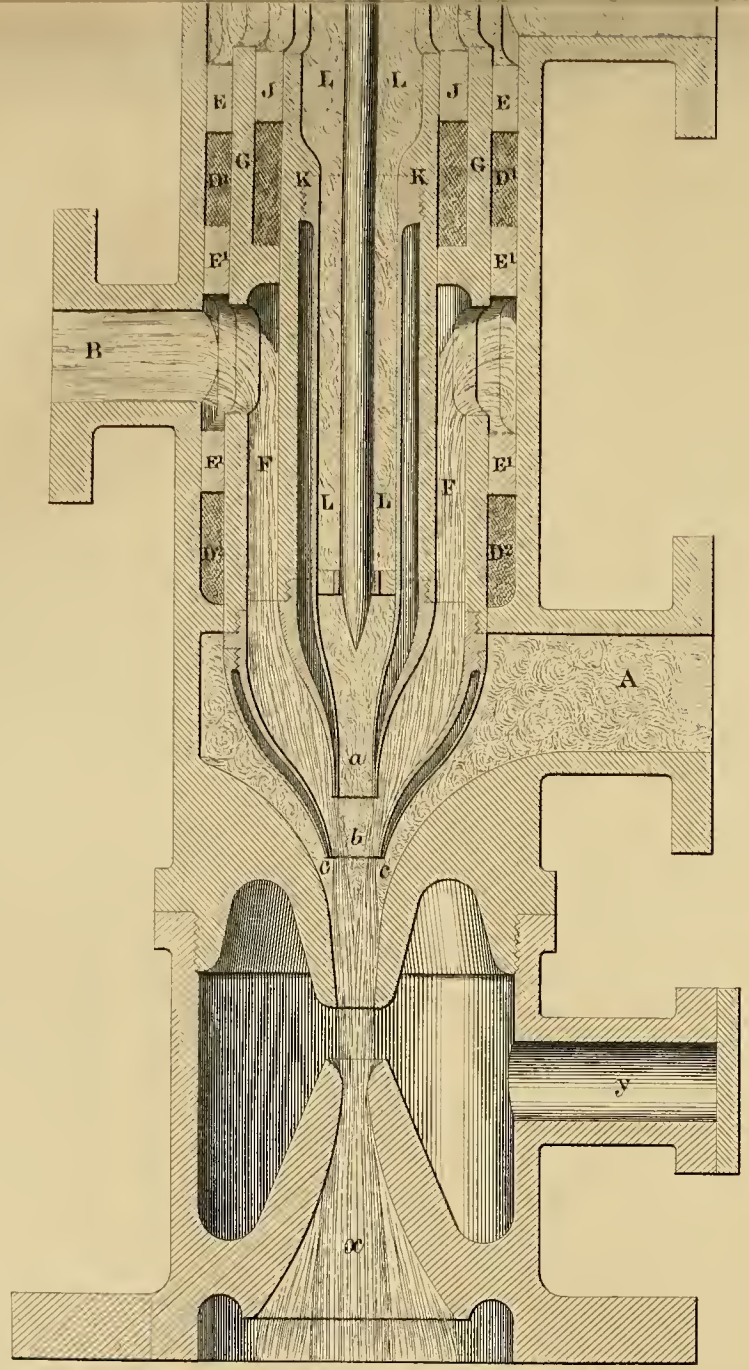
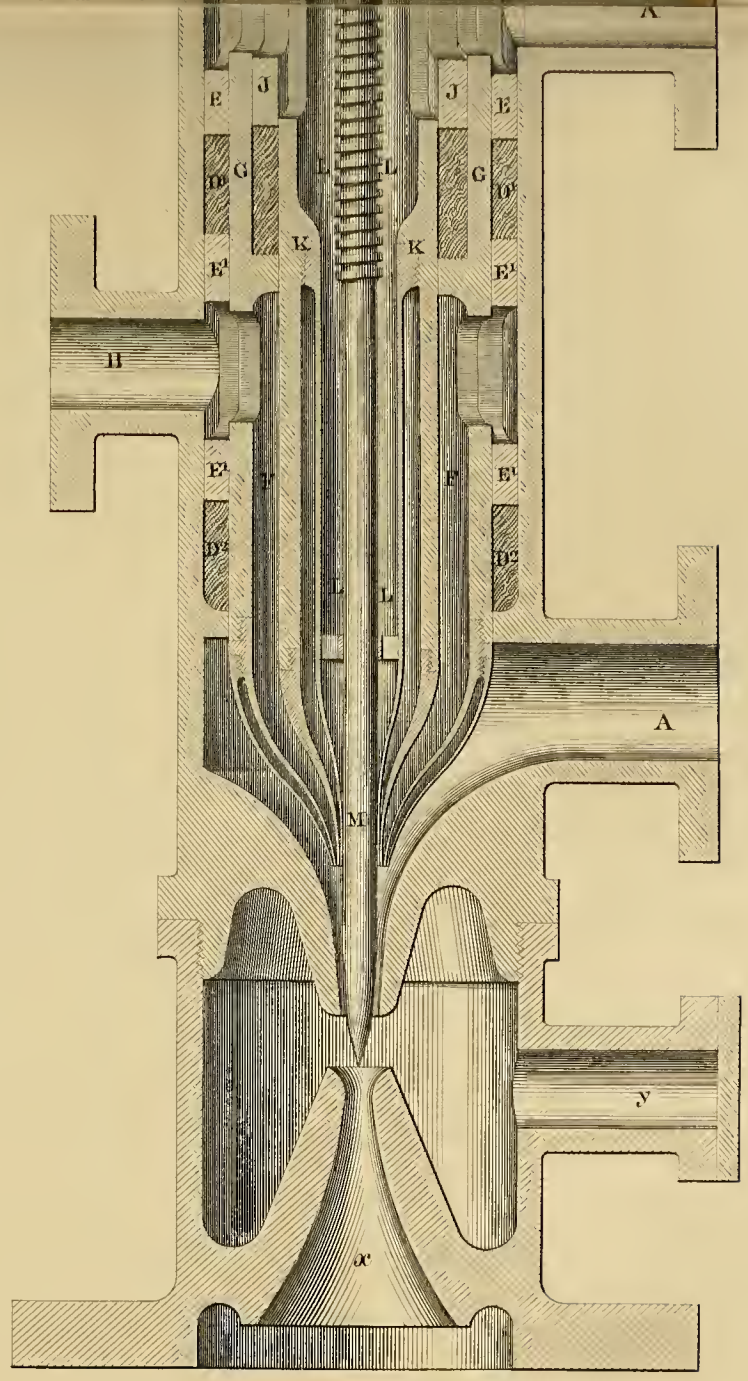



Fig. 2.






NOZZLE AND SPINDLE IN WORKING POSITION.




NOZZLE AND SPINDLE WHEN NOT AT WORK.

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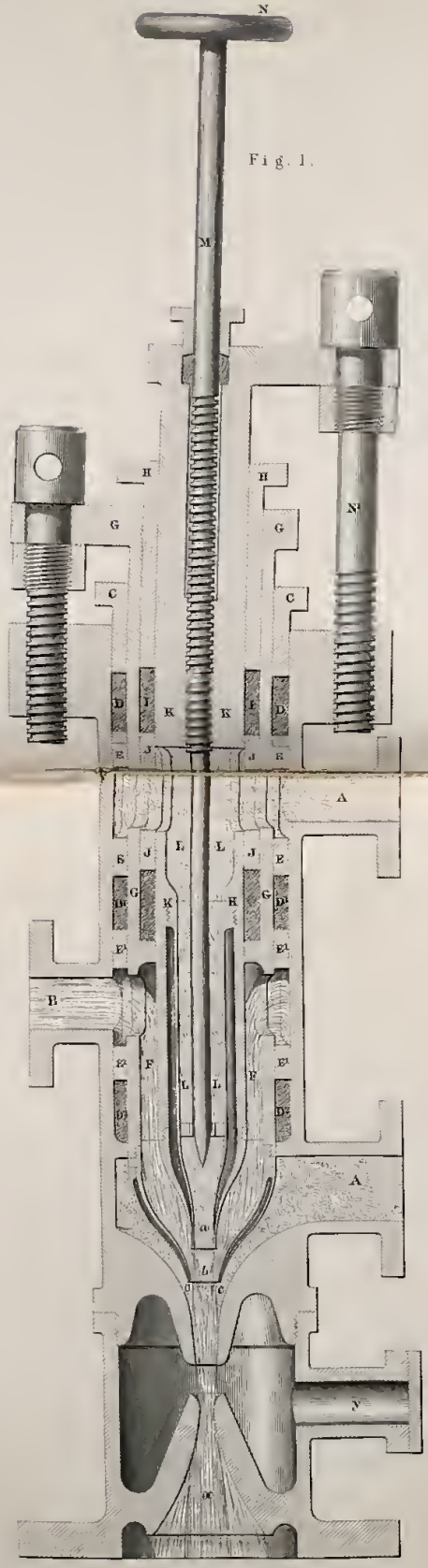
# BARCLAY'S "EJECTOR-CONDENSER" OF 1864.

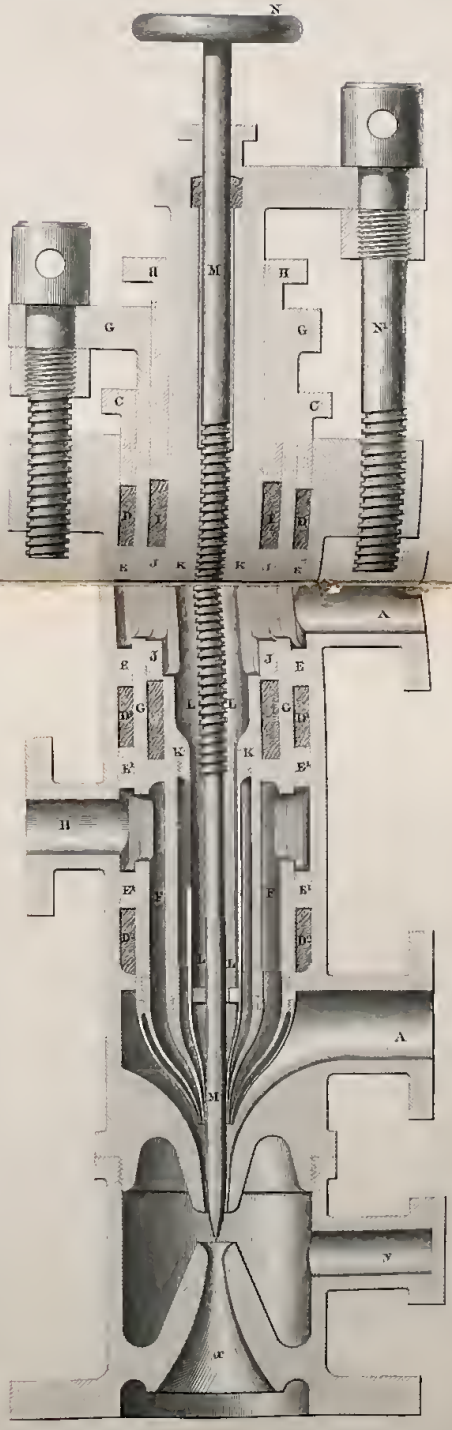


Fig. 1.




NOZZLE AND SPINDLE IN WORKING POSITION

Fig. 2.

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alternated by a charge of small coal or coke, or, what is better, of charcoal. The quantity of fuel should be increased in proportion to the required degree of carburation of the cast-iron. The tubes having thus been filled to the level of the flooring G, the covers are placed on the top, and the operator may then commence to heat the furnace. In lieu of charging the crucible-tubes with alternate layers of ore, flux, and fuel, these three materials may be previously mixed and supplied in that state to the crucible-tubes. As the fusion proceeds, and the charges 'sink' in the crucible-tubes, the supplies are renewed; and the operation may thus be carried on in a continuous manner.

When the slag has accumulated in the central basin C, which receives all the molten metal from the whole of the crucible-tubes B, it is tapped off through the apertures E, care being taken to leave a sufficient quantity to preserve the cast-iron from oxidising currents.

When a sufficient quantity of cast-iron has been collected in the basin C, it is tapped off through the hole D formed in the gutter. The cast-iron is either run direct into pigs, as in blast furnaces, or received into ladles, to be run into moulds.

For the manufacture of malleable iron direct from the ore, the same apparatus is employed.

The ore should be reduced to a metallic state, which is effected in a retort furnace and submitting it to an elevated temperature. The ore having been thus reduced, the operation is conducted, as for the manufacture of cast-iron, by charging the crucible-tubes with this ore mixed with the fluxes necessary for the fusion of the gangue. Great care should be taken to prevent any of the fuel from remaining with the ore, which in that case would be carbureted, and produce either cast-iron or steel, according to the quantity of fuel remaining mixed with it. The operation is continued, the same as for cast-iron, by charging the crucible-tubes in proportion to the progress of the fusion; and when a sufficient quantity of the molten metal has accumulated in the central basin C, it is run into cast-iron ingot moulds, or otherwise tapped off.

For the manufacture of steel, the process is conducted the same as for cast-iron and wrought-iron. The crucible-tubes B are charged with the iron-ore, reduced to a metallic state, and mixed with cast-iron fragments in such proportions as may be considered necessary for the due carburation required for the particular quality of steel to be produced. The tapping off is effected in the manner before described for cast-iron.

In producing iron and steel, the ore may, if desired, be treated directly without being previously reduced, the reduction being effected in the crucible-tubes; in this case iron and steel will only be obtained by the admixture with the ore in the crucible-tubes of a suitable quantity of carbureting material or fuel. For producing wrought-iron, such a quantity only of coal or charcoal is employed as may be sufficient for the reduction of the ore, but for steel rather more coal or charcoal must be used, in order to effect the required carburation.

The form of apparatus or furnaces employed in carrying the processes may be varied from that shown, and may contain a greater or less number of crucible-tubes, which may be heated either direct with any ordinary or other fuel, or by means of gas produced in a special apparatus.

## CONSTRUCTION OF BRIDGES.

JOHN HENRY JOHNSON, 47 *Lincoln's Inn Fields; a Communication from* RUFUS S. MERRILL, *Boston, U.S.—Patent dated July* 2, 1868.

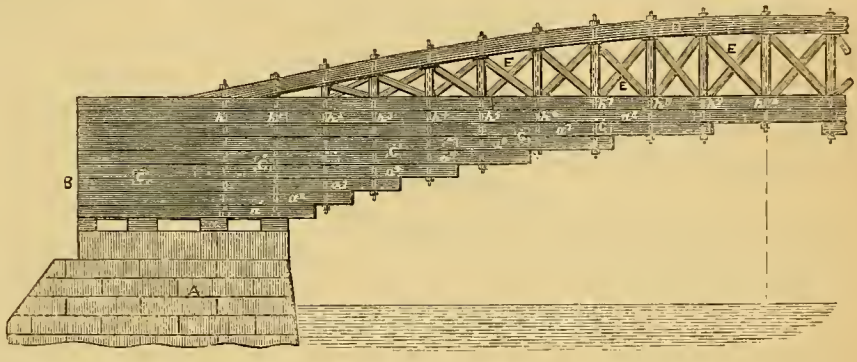
THESE improvements relate to a method of constructing bridges so that the temporary framework or scaffolding ordinarily employed to support the main structure during the progress of the work is dispensed with; and the invention consists, mainly, in the use of two or more levers projected from the opposite sides of the space to be spanned, and meeting in the centre, each lever being composed of a series of superposed layers, and each layer extending a certain distance in advance of the one immediately below, thus increasing by so much the projection of the lever.

The accompanying engraving represents an elevation of this mode of constructing a bridge. The bridge may be considered to consist of two or more levers projected from the opposite sides of the space to be spanned and meeting in the centre, each lever being composed of a series of superposed layers of timber, and each layer extending a certain distance in advance of the one immediately below, thus increasing, by so much, the projection of the lever.

A is one of the piers or foundations upon which the shore ends of the levers B rest. Each lever is composed of a series of layers $a$, $a^1$, $a^2$ &c. of timber, the bottom layer resting directly upon the base A. Upon this layer a second layer $a^1$ of timber is placed, which projects in advance of the first, and upon the second layer is placed a third $a^2$, and so on; the projection of each successive layer being gradually increased, so as to form an arch of the desired curve.

The timbers of the several layers are securely attached and held in place by means of pins or bolts, which are of sufficient length to extend down through one, two, or even more of the layers beneath.

The two levers B are held together by cross or bond timbers C $C^1$,




which not only serve to strengthen the bridge, but also form a frame upon which a temporary flooring may be laid, for the transportation of the material required as the work progresses and the projection of the bridge, or levers, increases. In proportion with the increase in the projection of the levers, their shore ends are weighted by means of stone-work masonry, or other suitable material, so as to compensate for the increasing weight of the projected ends; and by this means the levers may be projected without the aid of any supports or temporary framework beneath. When the levers, thus projected from the opposite shores, meet in the centre, a top layer of timber is laid, extending the whole length of the bridge from shore to shore; the bridge is now essentially completed, and needs only to have a permanent flooring laid in order to fit it for use. Its strength is very great, and it is built with but little expense and consumption of time.

A bridge constructed as thus described is fitted in most respects for ordinary use; but in order to impart to it increased stability and strength, it is proposed to combine with it truss-work in such manner that the bridge itself shall in effect constitute the bottom chord of the truss; and this constitutes the second part of the said invention.

In the figure D is the top chord of a truss, the extremities of which rest upon the bridge, or that part of the bridge which is supported on the pier A. This chord is held to the bridge by means of tie-rods and nuts $h$, $h^1$, $h^2$ &c. The rods $h$ extend down to the lower layer $a^1$ of timbers, and are attached by means of holding nuts, as shown. The next rod $h^1$ extends down to and passes through the projecting end of the succeeding layer $a^2$, and so on; each layer of timber being held at its projecting end by one or more of the tie-rods or bolts which unite it with the top chord D. The layers of timber of which each lever, and consequently the bridge, is composed constitute, therefore, the bottom chord of the truss. Cross-pieces or braces E are arranged in the spaces between the tie-rods on top of the bridge, so as to strengthen and hold them in position.

The third part of this invention consists in constructing a bridge of this class of iron or steel.

In order to make the bridge as light as possible without detracting from its strength, the different layers of which the lever is composed are formed of plates of angle-iron or steel. It is necessary that each plate should have at its top and bottom an angle or flange, so that it may be riveted to the plates of the layers next below and above.

Each lever is composed of two parallel sets of superposed layers of metal plates, held together by means of vertical or upright double angle-iron or H-shaped beams, to the flanges of which the plates of the several layers of each set are riveted. These uprights are arranged throughout the whole length of the lever, and extend up above the top of the bridge, so as to form the supports of the upper chord of the truss. The parallel levers are connected by cross-beams of the H form, the arrangement of which is similar to that shown in the illustrative figure.

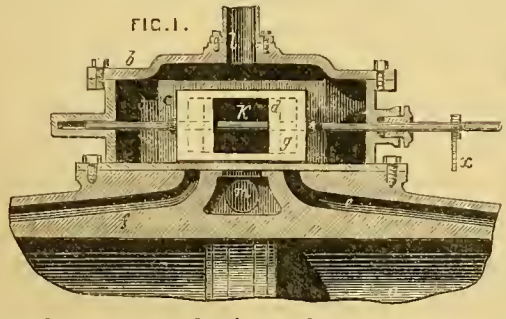
## SLIDE VALVES.

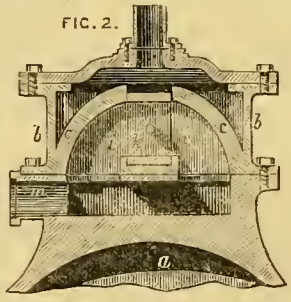
JOSEPH EDLYN OUTRIDGE, *Newport, Isle of Wight.—Patent dated August* 1, 1868.

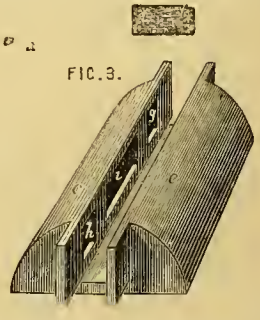
THESE improvements relate to a peculiar construction and arrangement of mechanism, whereby the pressure of steam and vacuum is removed from slide valves, and their free working obtained without friction upon their faces. This is accomplished by attaching to the ordinary valve-box of a steam-engine an apparatus consisting of one, two, or more castings, each casting containing ports or passages for the inlet and outlet of the steam. The faces of the castings which contain the ports or passages are opposite to each other, and may be fixed parallel to each other or otherwise.

Fig. 1 of the accompanying engravings is a longitudinal section, and fig. 2 a transverse section, of the valve applied to an ordinary steam cylinder. Fig. 3 is a perspective view of the casting constructed as hereinbefore described.

*a* is the cylinder; *b* the valve-box; *c* the casting; and *d* the slide, which is single; *e*, *f* are the two ports communicating between the valve-box and the front and back of the cylinder respectively. The casting *c* has two opposite faces, as shown, and is provided with a port or passage *g* in each face to communicate with the port *e*, and a port or passage *h* in each face to communicate with the port *f*. The casting is also formed with a central exhaust opening or port *i* corresponding with a similar opening *k* in the



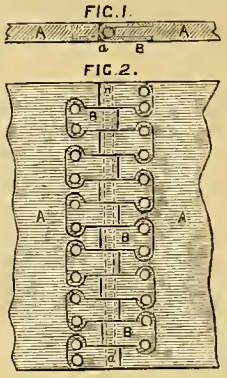

slide *d*; *l* is the steam supply pipe, and *m* the exhaust. In the forward movement of the valve the slide *d* passes the ports *h* in the casting, thereby allowing the steam to pass from the valve-box through these ports *h* to the port *f*, and thence to the back end of the cylinder; the opening *k* of the slide also in the forward movement uncovers the ports *g* in the casting, allowing the steam in front of the cylinder to exhaust through the port *e*, ports *g*, openings *k* and *i*, and passage *m*. The bottom face of the slide *d* is by preference kept a little above the bottom of the casting *c*, as seen in the figures, to allow the steam to flow between them. *x* is a lever on the slide rod; when pressure is put upon this lever by a spring, weight, or otherwise, the flat part of the slide rod keeps the slides to their faces.

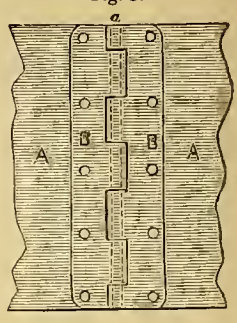
## DRIVING-BANDS.

BERNARD PEARD WALKER, *North Road House, Wolverhampton.—Patent dated July* 7, 1868.

THE improvements specified under these Letters Patent relate to a mode of joining driving-bands of leather, india-rubber, or other materials so as to avoid the objectionable overlapping which is now necessary in the ordinary way of joining belts, at the same time the belts are as strong at the junctions as in any other part.

Fig. 1 of the annexed engravings represents a sectional view of a portion of a 4-inch driving strap, the ends of which are joined according to one modification of this invention. Fig. 2 is a corresponding




plan of the same. A represents a portion of a driving-belt or strap, and B B a series of sheet-metal clips which are made by punching out a flat piece of sheet-steel or other metal (fig. 2) from a large sheet, and then bending the piece so punched out into the form shown at fig. 1; holes being perforated therein for the reception of rivets, screws, or other fastenings. These clips are secured by rivets or otherwise on to the two ends of the strap or belt to be joined, the clips on one end of the belt being placed opposite the spaces between the clips on the opposite end of the belt, so that when the two ends are brought together the clips (which are caused to project beyond the ends of the strap) will interlock, as shown in the plan. By passing a hinge-pin *a* through the loops or openings in the several clips, the two ends of the belt are securely joined together, such join being perfectly flexible, or possessing the properties of a hinge, of which the pin *a* forms the hinge-pin. It is obvious that, by having a number of loose clips B, and a length of wire of such thickness as to fit the clips with some degree of accuracy, driving-straps or belts of any width may be joined in this manner by simply securing more or less clips to the belt, according to its width, and passing a suitable length of wire through them. If found desirable, special provision may be made for preventing the wire or pin *a* from working out; as, for example, by bending or riveting the ends, or by providing a head at one end and a small screwed nut on the other end, which is to be screwed on after the pin has been passed through the clips.

In place of using several separate clips, the joint may be made of a single pair of plates B properly perforated, so as, when bent, to enclose the ends of the belt A and form interlocking joints, as shown at fig. 3.

In cases where the necessity for flexibility in the joint is not great, as in the case of large driving pulleys, the joint or hinge-pin *a* may be dispensed with and the junction effected by riveting one or more pairs of straight flat links, of the same or similar shape as those from which the first described clips are made, or of any other suitable shape, on either side of the strap or belt A; using so many as may be required, according to the width of the strap or belt.

## ORNAMENTING SURFACES.

BENJAMIN NICOLL, *Regent Street.—Patent dated October* 26, 1868.

THE patentee's improvements have reference to a simple and effective mode of decorating the internal or external surfaces of walls, floors, pavements, roofs, ceilings, and other parts of buildings, and consists essentially in the employment for such purpose of a peculiar composition which is to be applied to the surface to be ornamented in a similar manner to plastering, and when set or hardened may be ground, smoothed, and polished if desired, and further ornamented according to taste by cutting, moulding, gilding, or otherwise in any required pattern. This peculiar composition consists of a species of scagliola composed of chalk, ordinary cement, and, if desired, colouring matter, by preference mineral colours, according to taste. The patentee has found that 100 parts by weight of chalk to 50 parts of cement will give a good result, but he does not confine or restrict himself to these precise proportions. This is to be mixed with water to the consistency of plaster and spread out in the form of a sheet or thin layer to dry and harden ; when thoroughly dried the composition is to be broken up into fragments of irregular form and size, according to the effect to be produced. These fragments are subsequently mixed with a semi-fluid or plastic mixture of ordinary cement and chalk, which latter substance may be tinted as required by the addition thereto of any suitable colouring matter, to form a good ground for the reception of the fragments above referred to. This compound is to be applied to the surface to be ornamented by the aid of a trowel or otherwise, and when it has dried and hardened the surface may be ground, scraped, and rubbed with a wire brush or otherwise treated to produce a level or smooth surface and subsequently further hardened by the application thereto of a solution of silicate of soda ; this composition is capable of resisting the action of moisture, and may be washed and cleaned with ordinary soap and water as often as may be found requisite. Any design or pattern may be sunk in the surface of the said composition, and gold leaf, coloured plaster, or composition, or other ornamenting material introduced into such sunk portions.

## LAW REPORTS.

CARTRIDGE CASES.—DAW *v.* ELEY. The Rolls Court, April 21, before the Master of the Rolls. Mr. Manisty, Q.C., Mr. Jessel, Q.C., Mr. Macrory, Q.C., and Mr. Russell Roberts appeared for the Plaintiffs ; Mr. Grove, Q.C., Mr. Southgate, Q.C., Mr. T. Aston, and Mr. Langley appeared for the Defendants.

The suit was instituted by Mr. G. H. Daw, of Threadneedle Street, to restrain the Defendants, Messrs. Eley, from manufacturing or selling cartridge cases for breech-loading firearms, in infringement of the plaintiff's patent.

Mr. Daw's specification, filed the 7th of September, 1867, stated as follows :— "This invention has for its object improvements in the construction of cartridges for breech-loading firearms. Cartridges for breech-loading firearms have heretofore, in some cases, been made with the case which is to contain the powder formed of a tube of metal ; the tube has either been a drawn tube, or it has been a tube or hollow roll formed by winding sheet metal aronnd a mandril. Snch metal tubes have also at one of their ends been combined with a base (mainly composed of paper or pulp, and formed by the process known as 'Daw's process'), carrying in its centre a percussion arrangement for igniting the powder. According to my invention I construct the case of the cartridge of a metal tube formed from a strip of thin rolled sheet metal bent over a mandril, and having its overlapping edges soldered or cemented together so as to form a perfect tube. One end of the tube so formed is, as heretofore, combined with a base carrying a percussion arrangement, and the other end is closed by the projectile, after the case has been filled with powder. By thus constructing the case of a strip of thin sheet metal soldered or cemented at the edges, and so formed into a tube, much less metal may be employed in forming the case than heretofore. The empty cases are also very readily extracted from the chamber of the barrel after the cartridge has exploded. The tubes are of a conical or cylindrical form, or conical and cylindrical combined."

The patent of which this is the specification Messrs. Eley were alleged to have infringed by manufacturing and selling cartridge cases of thin sheet brass, lined with paper or thin pasteboard, made in accordance with Rochatte's patent of the 29th of Jannary, 1867, of which the defendants are the proprietors.

His Lordship said that after reading the evidence and pleadings carefully he could not avoid coming to the conclusion that Daw's invention was no subject of a patent. The plaintiff had stated in the specification, "What I claim is the forming a cartridge case by combining with a base-cap or capsule a powder case made from a strip of thin rolled sheet metal, soldered or cemented up at its overlapping edges, and so formed into a tube." For a patent privilege to be good either the invention must be new, or there must be a new application or a new combination ; but there was nothing of that kind in this patent. Nobody could contend that the tube was a new thing, or that the tube combined with the capsule was a new thing. It was admitted that tubular cases were in use before the date of the plaintiff's patent, and in his opinion the plaintiff's way of making the tube was as old as any other. It was claimed that by the plaintiff's method much less metal might be employed. That only meant that the tubes might be made of very thin metal. The tubes had been made of metal before, and the material was not the subject-matter of the patent. It had been argued that, admitting the tube not to be new, and the method of joining the over-lapping edges not to be new, still there was a novelty in the soldering the whole length of the tube, which, combined with the rest, might be the subject of a patent; but the specification stated that it was not essential, but only desirable, that this should be so, while the mere soldering a tube along its entire length could be nothing new. There was some novelty perhaps in the use of cement, which the Plaintiff said in his specification might be new, but not so conveniently, but not enough to be the subject of a patent. Dr. Miller's evidence was to the effect that the heat of the explosion (between 1,000 deg. and 2,000 deg. Fahrenheit) would melt the solder or cement and allow the tube to expand in the chamber of the firearm, and that the tube would be reunited immediately on cooling. This might be the case with solder, but with the cement he apprehended that the effect would be to burn it up and prevent the overlapping edges from reuniting. The fact was that the plaintiff's cartridge case presented three features in combination, each of which was by itself nothing new. These were thin sheet metal, solder or cement, and overlapping edges, and in his Lordship's opinion, they could not be when in combination the subject of a patent. There was not the slightest pretence for saying the invention was new in this respect, even if the plaintiff had not been forestalled by Rochatte, whose specification, it would seem, had been published prior to the date of Daw's patent. The patent was worth nothing, and the Bill which was to restrain an infringement of it must be dismissed with costs.

## REVIEWS OF NEW BOOKS.

*Treatise on Valve Gears, with special consideration of the Link Motions of Locomotive Engines.* By Dr. Gustav Zeuner. 3rd edition. Translated into English by Moritz Müller. 1 vol. 8vo. illustrated. Spon, London, 1869.

*The Slide Valve practically considered.* By N. P. Burgh, Engineer. 2nd edition, 1 vol. sewed, 8vo., woodcuts. Spon, 1868.

*The Indicator Diagram practically considered.* By N. P. Burgh, Engineer. 1 vol. small 8vo., woodcuts. Spon, 1869.

THE first-named of these works, in its original language, is *the* treatise on Valve Gear of all Germany, and well deserved being made available to English engineers generally, as it now has been, through the industry of Mr. Müller and the enterprise of the publisher. Dr. Zeuner, though not as fully known to fame in Great Britain as he should be, is well known abroad, as ably holding the chair of Applied Mechanics in one of the first technical schools in the world, that of the Confederate Cantons at Zürich.

It was even time that justice should be done to Zeuner himself, by enabling the English public to give him the merits which justly belong to him ; his graphical method of setting out valve gear, and much besides, having been for a long time past deliberately and largely pillaged by two or three pretty notorious writers on steam or locomotive engines, and in most cases without the smallest acknowledgment. The work of Zeuner is both theoretic and practical. Theoretically it deals with all the movements required by perfect conditions for economy of heat in valve motions ; with one valve, with two valves, with simple gear and with complex, reversing and link-motion gear ; and evolves rules and produces diagram methods for deciding upon the proportions &c. of all these valve gears, reduced to the concrete form. The method of treatment throughout is uniformly based on pure kinematics, and is elegant enough to warrant its style being called "classic."

But although, generally, no more mathematical knowledge is required for its study than that of elementary algebra and trigonometry, we fear it is not likely to be generally read, except by the younger and better educated class of our race of engineer students. Zeuner himself, in the preface to his third German edition, well and forcibly points out that this accurate and searching treatment of that which, as it were, gives to the nostrils of the steam-engine its breath of life, the valve, is the necessary and real road to the improvement of the machine, taken apart from the boiler. Contrary to the whimsical nonsense of some late Laputan philosophers—who affirm that the steam-engine's days are nearly over, and that the poor decrepit tool of the dark age of James Watt is about to pass away, as a principle incapable of improvement, and be superseded by Ericson and bottled sunbeams, by the actual and present realisation of the scheme which the fer vid fancy

of Swift chalked out as one only *proposed* by the sages of Laputa, "for rearing cucumbers in winter"—Zeuner has shown in his fundamental work on the theory of the steam-engine (*Grundzüge der mechanischen Wärmetheorie*, 1866) that the action of heat in the steam-engine does not widely depart from those conditions which theory points to as giving the greatest yield in work from a given unit in heat; and that if it be the fact, that actual steam-engines fall short (boiler and engines together) of realising more than about 10 per cent. of the work, theoretically in the fuel they consume, the fault is to be sought, not in any mistaken general notion of the machine, so much as in structural errors in its parts. These abound in the boiler, and in the engine itself are mainly to be sought for and remedied by an exact and complete study of the functions and movements of the valves.

This could never have been made matter of certainty, before the application of the laws of heat as a mode of motion as the fundamental theory of the steam-engine, enabled the real work in the fuel to be known and that of the engine for the first time to be compared with it. Of Zeuner's work we cannot afford space to treat as it deserves. We must add, however, that the methods of polar diagram which he has applied to the various known forms of valve and gear, as above stated, supply the means of arriving at like knowledge and results as to any new valve and gear whatsoever; they are general.

Of Mr. Burgh's little volume on the slide-valve we can speak with nearly the same commendation. It may be viewed and advantageously studied by those whose education makes Zeuner a sealed book to them; or by those who have studied the latter, and really wish to master their subject in every sense, as the proper complement to Zeuner.

Mr. Burgh's methods are, so far as diagrams go, based on Zeuner's; but everything is viewed here in the practical light of the workshop, and with good examples of how the principles inculcated have been carried out by some of our best engineering firms. The most essential questions in relation to valve gear—and no working man who is ignorant of them is fit to be entrusted with the management, much less repair, of either a land or a marine engine of any magnitude—such as the effect upon the successive positions of the valve of the length of the connecting rod, and also that of the excentric rod or its equivalent—are extremely clearly put and well illustrated, and simple diagrams and rules are given for finding the errors of traverse and their correction.

The three last chapters are wholly of a practical character, and treat of the proportions of slide valves as employed by our great engineering firms—Penn, Maudslay, Ravenhill, Watt, &c.; with eleven illustrated and illustrative examples, and of modes of packing, balancing, &c.

Mr. Burgh's still smaller volume (smallness is here itself a virtue) on the Indicator, supplies a want in a direction experienced by many a man fresh from the "drawing-shop" who for the first time comes to take an indicator card, and who finds that though he is quite up to the principles of what he is about, he has to contrive and grope about for the actual method by which he shall best obtain the necessary motion for his "card" from the engine he proposes to "indicate."

The pointing out the various ways with different classes of engines in which this is best done, the precautions to be taken &c., are the characteristic features of Mr. Burgh's work. Upon the general principles involved in the Indicator, the work of Mr. Porter, noticed a good while since in these pages, left little to be said by any one else, except upon those points of practical appliance to the working engine of which Mr. Burgh has here treated; so that his is a useful supplement to Mr. Porter's.

With all these volumes on indicators and diagrams, however, we would ask, How is it that no one has written one upon the continuous or integrating indicator (*Indicateur totalizateur*) which records automatically the work given forth by an engine at every moment for any length of time? Such indicators are in frequent use abroad. One of them, the *Totalizateur* of Ponnelet, was at work in Manchester for many months, quite fifteen years ago, and was examined by us, as applied to a pair of heavy cotton-mill engines. No ship of the French navy (we believe) is sent to sea without one of these instruments, made upon the beautiful construction of Mons. de Taurines, of Paris, being attached to the engines.

The record tells a tale, the truth of which no "log-book" colouring, or gracefully-worded official reports, dare contradict; and supplies, in fact, the only true basis for knowing what goes on in the "duty" of machinery and ship, as well as in the duty of the stoker and engineer.

We are not aware whether anything of the sort is employed by our Admiralty, but we believe not; and if not, why not?—Ed.

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*Traité de l'Exploitation des Mines de Houille, &c. &c.* Par A. T. Ponson, Ingénieur civil. 2nd Edit. by Jules Ponson. Liège and Paris. 2 vols. and Atlas.

This able and complete work on coal-mining has been somewhat improved in this its second edition. It is a tolerably exhaustive treatise from the Belgian point of view of its entire subject; not better, however, than one or two French works on the same which we have ere now reviewed in these pages.

In one of its most interesting and important sections, that on shaft-sinking through water-bearing strata of running sand and mud, we observe with surprise the absence of any notice of some of the most ingenious and effective contrivances that have advanced this part of the pit-sinker's art; and this is the more remarkable, as these are of origin so close to Belgium as to be almost Flemish. The Atlas of Plates published along with the first volume, which is all we have as yet received, is well executed, and the details, both as to coal formation and the tools &c. for working coal, clear and good.

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*Traité pratique de l'entretien et de l'exploitation des Chemins de Fer.* Par Ch. Goschler, Ingr. &c. 8vo. Baudry, Paris, 1868.

This able systematic work upon the maintenance and working of railways, the two first volumes of which we reviewed a good while ago, has now reached its third and fourth, or concluding volume. The two first, it will be recollected, treated of the material and *personnel* of railways; now we have their keeping in repair and making good use of them systematised and treated of with clearness and great practical ability.

The work ought to be a *vade mecum* to every chief servant in the employ of every railway in Great Britain, or at least all such would profit by its study; but for this a translation into English must be had, and we see on the title-page *tous droits réservés.*

The third volume treats of engines and rolling stock in general, with engine and carriage shops and systematic arrangements as to working and repair—tools specially suited to such establishments—and of the whole *pathology*, as we may call it, all the maladies, accidents, and diseases to which engines and carriages and wagons &c. are subject in their life and conversation, and the best means of cure when they are brought to hospital.

We have some valuable *généralités* towards the end on the various fuels used on various lines and on their respective evils and advantages and relative cost &c. Turf as a locomotive fuel is treated of, from the experimental and actual point of view, and some facts not commonly known in Great Britain are given. The State Line of Bavarian Railway has been worked with turf since 1847, or for above 20 years, rather from necessity than choice.

The peat is got from the bogs of Haspelmoos, and the particulars of its preparation mechanically are given. The methods pursued are those of M. Exter, whose statement is that he can produce 10,000 cubic metres of prepared turf per annum at a cost of 2·80 francs per metre. The turf, as dug or dredged, appears loaded with much admixed earthy matter; from this it is separated by grinding up, large dilution with water and decantation of the water bearing the light peat particles still in suspension from the heavier earthy matter which has deposited.

This is let to dry in layers exposed to the air like "hand turf," and then compressed in moulds by power. M. Goschler says—and we believe, from every other analogous source of information on the subject of artificially prepared peat, quite correctly—that these results admit of being contested. As a locomotive fuel, turf at the best is a bad and troublesome one; it gives much smoke and sparks, leaves an evil smell after it, experienced in the train, and is so bulky as often to need supplementary wagons to feed the tender

on a long run. There is also great waste by the broken particles passing through the fire-bars.

As to comparative heating powers (not theoretic, but taking into account all these circumstances), the result of nine years' working on the Bavarian State Line indicate, according to the author, that 100 cubic feet or 2·486 cubic metres of the prepared turf of average quality and dryness are equivalent to 312·5 kilograms of coke or to 3·135 cubic metres of white firewood, i.e., of wood principally of birch, beech, and alder. Thus during this interval of working the cost of firing with turf was about half that of coke (*in Bavaria*) and two-thirds that of wood. But taking everything into account as derived from the accounts of the line for 1861-62, M. Goschler shows that even this is too favourable, for that the fuel account per kilometer per engine (as we understand him) stands thus—

| | Fired with Coal | Fired with Peat |
|---|---|---|
| Passenger Engines | 0·166f. | 0·172f. |
| Luggage Engines | 0·249 | 0·207 |

It is thus, though rather cheaper than coal for slow traffic, a trifle dearer than coal for fast, and that even in Bavaria, where coal was then exceptionally dear.

The fourth and last volume treats at large of the *ordonnance* and government of railways and their working, and many of our Railway Boards would learn a good deal of what they seem too often to know very little about by the diligent study of what is here so well systematised and so rationally and practically set forth. This part ends with an excellent sketch of what railway accounts ought to be, and apparently what they are to a great extent in France.

In an appendix to this part we have, amongst other very good sections, one treating of economic railways of small guage, which describes nearly all those which so far have been constructed.

The superintendents of the carriage departments on our great lines will find more to instruct them in specifying for their stores and in other matters of their daily duty than a good many of them in our self-complacent nation may be disposed to suppose.

The third great division of the volume treats of all that brings the railway system and the public personally into contact, either as carriers of passengers or of goods: this is the goods and station managers' portion of the work. In a luminous chapter on railway accidents, M. Goschler sums up, as the results of his accumulated observation and the experience of himself and others, the main cause of accidents to be: overwork of certain lines in proportion to the staff of servants employed, and the thronging or glut up of goods or passengers, or both, at certain points of lines, whether in continuation or by junctions.

We shall not follow him into his suggestions for palliation or remedy; our readers specially interested must consult the work if they are to do justice to either it or themselves.

The last portion of the work is destined to the *administration*, or, as we say, the direction of railways; to the government of all in supreme by boards and boards' officers and servants, &c.

And here we have sketched in a masterly way how all this should be arranged and worked, so that the contact between the railway system and that portion of the public which has provided the capital to make it shall be complete and secure.

There are again here appendices of much value on the connection between railway system and telegraphs &c. &c.

How is it that we, who pride ourselves on being what we call "a practical people," so generally affect to undervalue the clear thought and order-endowing mind and habits that produce such a work as this? Must we not do better had we ourselves more of it?

ED.

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*Modern Screw Propulsion.* By N. P. Burgh, Engineer. 4 parts, 1 to 14. Spon, London.

IF this be not the most important work upon the screw propeller which has issued from the press, it is at least unique in one respect, that it embraces monographs, by almost all the great improvers or constructors of this instrument of propulsion, in which each describes lucidly and fully the principles (to some extent), always the steps, by which he advanced to his own improvement. Thus we have such accounts at first hand of the Griffiths Screw, the Dudgeon Twins, Penn's *lignum vitæ* bearings, Symonds' securing of the twin screw, and many others.

The work is led off by an introduction containing an interesting—because in great part stamped by individuality—history of the rise and progress of the screw propeller, contributed by Mr. G. B. Rennie, of the firm of Rennie and Sons. The first practical and actual demonstration of the use of the screw propeller Mr. Rennie attributes to Shorter, who early in this century fitted it to a ship of the line, *The Superb*, which he succeeded in driving at the rate of two miles per hour.

In reality, as it appears to us, the history of screw propulsion presents one of the most remarkable instances, in the whole range of mechanical improvement, of how little theory has done—or, in its present state as to hydro-dynamics, can do—in the way of indicating results, predicting or guiding improvement, or stimulating experiment.

The whole career of the screw has been one of surprises—of tentation, of trial and error, and of gradually groped-out success.

Daniel Bernouille had, as early as 1752, imagined an arrangement tantamount to the screw. Scott of Ormiston thought much of a screw revolving in a cylinder whose axis was in line of the keel; and the twin-screw was tried by Whytock, we believe in presence of Colonel Beaufoy, who states that screw propulsion came from China; and Lyttelton tried the twin-screw on a pretty large scale, but with ill-success. Tredgold, writing certainly before 1826, after some investigations as to the propelling power of the screw, which we must now view as very crude, says: "These calculations are sufficient to show that this method may be used with considerable advantage, the action being under water and the projection from the side not so great as paddle-wheels, while the smoothness and uniformity of the motion are much in its favour. On the other hand, the mode of communicating the motion and the resistance the parts will offer that are applied for that purpose, are objections; and for the present I shall therefore content myself with recommending it to the notice of my readers." Looking at these facts—and the many others which Mr. Bourne, in his more elaborate history of the invention of screw propulsion, has collected—and also at the circumstances that, very much like as the results of the Rainhill incline locomotive trials took railway engineering by surprise or by storm—so the success of the Archimedes ship and screw, in the hands of Smith in 1839 (as to which experiment we learn from Mr. Rennie that *Herapath's Journal* of that date declared that "the expectation of success was at a very low ebb"), took the whole world of steam marine engineering by storm. It was seen, in fact, that essentially the plan was good, and that what was needed was to work out particularly its details—principally proper form and proper velocity—for given conditions. The march ever since has been one of tentation; and, valuable in some sense as have been the contributions to our knowledge of the subject derived from mathematical investigation by Rankine and some others, the real advances appear to have been made by common sense, directing repeated and gradual changes of form, &c. &c. These have had their reward; for it needs but a slight survey of the existing state of steam navigation to see that the screw is destined ere long, except for a few very special purposes, to supersede altogether the earlier paddle-wheel, though perhaps the screw itself may be hereafter superseded by some other yet unthought-of method. Even water propulsion may yet have its *avatar*; and we may yet see that, so far, its comparative ill-success is due not to inherent bad use of principles, but to our hydrodynamic ignorance and mechanical errors in its application. This much at least we may venture to say, that if there were something inevitably tending to an enormous waste of power (as some say there is and must be in water propulsion), it is scarcely likely that Nature or Providence would have created such vast numbers and species of marine organisms dependent upon it for their means of locomotion—*nec deficit, nec abundat.* She, Nature, wastes nothing; she would scarcely have made marine water-propellers at all, if in *her* hands they were not efficient instruments, not wasteful of their prime mover, vital and muscular force.

However, the history of screw propulsion has been a practical one by experiment; and hence the subject is pre-eminently one of those in which careful, complete, and trustworthy treatment by the record of facts is the best possible that can be given it. That is just the characteristic of Mr. Burgh's work; our judgment upon

which we have waited until now to form, when fourteen out of his sixteen parts, which are to complete the work, are before us. Every part contains extremely well-executed and distinctly-drawn designs, from working drawings in fact, which embrace together all the known important varieties of the screw, as constructed by all our great naval engineers and engine-builders. There is no use in recapitulating them; they are all there, and in nearly every case the monograph, by the maker himself, to explain and comment upon his own system or his own designs.

Besides this Mr. Burgh, both as author and editor, gives throughout a running commentary; and, under the head of what he calls the "geometry of the screw propeller," gives excellent diagrams for the aid of the student, as well as for the higher class of "pattern-makers" entrusted with screw-blade patterns &c. in striking out the true form of every form of screw, however complex.

Much exception has been taken ere now to a certain peculiarity of English in which Mr. Burgh has expressed, and sometimes rather obscured, his ideas; which are always good and sound as to practice, although now and then not perhaps quite sustainable in their theoretic enunciation; however, in this work, no fault can be found, either with the language of his eminent contributors or with his own.

There is but little purely theoretic matter in the work, and, we believe, not a single algebraic symbol to be found on its pages, and, as we have said so, best, in view of the peculiar nature of its subject; which to be best treated will be treated most practically, i.e. by appeal to the best practical results that have been achieved by the best practical marine-engine makers, and by development in minute detail of the exact means by which they have attained their respective successes. This is just what Mr. Burgh has done. A very good popular *résumé* of the entire career of the screw, and of each step of change and of improvement, has been given by Mr. Burgh, in a Lecture delivered by him at the Society of Arts, Adelphi, in the month of March of this year (1869), and since printed (by Messrs. Spon) in a separate form.

We commend this to the *gens de monde*, as well as to our own readers.—Ed.

*Worssam and Co.'s Illustrated Catalogue of Wood-working Machinery, Oakley Works, King's Road, Chelsea.* Folio, 1869. Illustrated.

This is one of the most copious, complete, and handsomely got-up trade catalogues of any British tool-making establishment that we have seen. Dimensions, weights, speeds, power to drive, work done per hour, &c. by most of the tools are given, and the Catalogue is really a very good and valuable practical guide to wood-working machinery of the best and most recent descriptions.

Although by title limited to wood-working machine tools, in reality it is still more comprehensive, and embraces punching presses, crab and crane machinery, marble-sawing and grinding machinery, mortar mills, and several others, which the issuing house have made their specialities.

*Appleby's Illustrated Handbook of Machinery and Ironwork.* By Appleby Brothers, Engineers, Southwark, London. 1 vol. 8vo. Illustrated, 2nd Edit. Spon, London.

This is another and in some respects even more sumptuously got-up trade catalogue than the preceding.

It is not only a catalogue with prices, working expenses and results, but a treatise upon nearly all the multifarious tools, implements, and machines commonly employed by civil or mechanical engineers, contractors, &c. or shipped by merchants for their and like uses in foreign markets. Many of the woodcuts are superb specimens of wood engraving, and their number throughout the well-printed pages is almost numberless. There is this difference between the two catalogues, however—that while Messrs. Worssam and Co. are the actual manufacturers of all they catalogue, for a vast variety of the articles shown in Messrs. Appleby's we must presume them to be only agents for their sale. This, however, detracts nothing from the value of the great *vade mecum* of appliances, which ought to be pre-eminently useful to engineers and contractors on foreign works or stations.

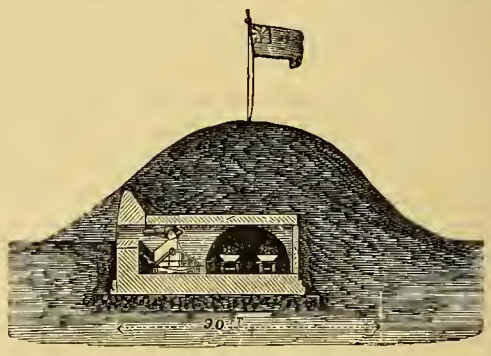
## CORRESPONDENCE.

☞ We do not hold ourselves responsible for the views or statements of correspondents.

### FORTIFICATIONS.

TO THE EDITOR OF "THE PRACTICAL MECHANIC'S JOURNAL."

Sir,—We may say, as far as we have gone, that fortifications have crumbled in the dust before the tremendous ordeal they have been subjected to; the powerful guns recently introduced have done great havoc in the peaceful tilt. Engineers have done all they can to make the machinery perfect, and now they have attained such high excellence, and their many fine parts have been so elaborately executed, that the gun requires to be properly protected. We have spent millions on fortifications, and notwithstanding the improvements introduced by Captain Moncrieff, I certainly think that we shall require to protect his gun carriage from the influence of the weather, as likewise from the vertical fire of the enemy; and in doing so I have another object in view, namely, to provide work for England's navvies: those hardy sons of the soil must live, or emigrate. If our sea-girt isle require to be fortified, let us do it well when we are about it, eschew all rubbish we have been about, and



take a lesson from the "Woolwich butts;" form a bank of earth round Great Britain if you will, and trust more to "soldiers" than "Jack tars," more especially when they are to be cooped up in that great abortion, low-lying turret ships. I will not dispute that such craft are very handy in smooth water, but this I must say, that we shall always be able to have heavier guns on shore than afloat, and that our harbours and mouths of rivers must be protected with land batteries.

The sketch shows an improvement over that I communicated some time back. Of course, the nature of the ground must determine the form of the fortification, although the mode of construction will not be materially altered. The central arch, of strong brickwork, contains two sets of rails for the ammunition wagons; in action they would be placed between the gun-rooms—thus they would be fully protected; turntables would be fitted, so that one set of rails would be the feeder, while the empties would be shunted and again replaced with full wagons; thus the guns could be served independently.

The gun-rooms are simply arched over, while the embrasure is protected with a solid block of cast-iron—no mere plate, but a solid lump, that may be cast "in situ," or a series of large lumps securely dovetailed together—if that "cast-iron" protection is made large enough and properly formed, I think its merits consist in its cheapness and powers of endurance; its length in the line of fortification will just be sufficient to protect the brickwork, the whole of the work being covered over with a deep mound of earth, and of sufficient depth to meet all the manœuvres of the enemy. Should an elongated projectile find its way through the embrasure, it simply knocks a hole in the slight back wall and buries itself in the earthwork. Such a system of defensive structures can be arranged for the great horse-shoe battery, or end-on fire; and although I have given the Moncrieff system the preference, I consider for any gun earthwork fortifications combine what is required, namely, strength and cheapness.

I must apologise for again troubling you on this subject.

I am, Sir, yours truly,

13 Gladstone Street, John G. Winton.

14*th April*, 1869.

## PROCEEDINGS OF SCIENTIFIC SOCIETIES.

### ROYAL INSTITUTION.

February 12, 1869.—Col. W. F. D. Jervois, R.E. C.B., on "The Coast Defences of England."

February 26, 1869.—John H. Bridges, M.A. M.B., on "The Influence of Civilisation upon Health."

Health may be defined as *the greatest energy of each part compatible with the energy of the whole;* or again, more simply, as, *being able to do a good day's work easily.* Energy is measurable by the amount of work done. Where there is perfect health there will be the greatest economy of the vital energies; the most complete *synergy* of the functions, the minimum of loss from antagonism, or from degradation of higher into lower forms of force.

Again, health may be defined as *the most perfect form of Life.* Life having been defined by Anguste Comte as the constant adaptation of organism to environment, health is the state in which such adaptation is most complete. Healthy respiration implies the adaptation of a breathing apparatus hereditarily vigorous to

a perfectly pure atmosphere. Healthy vision implies a sound ocular mechanism adjusted to appropriate conditions of luminous forces.

Statistics were produced showing that in 1811 the towns above 10,000 inhabitants contained only 24 per cent. of the population ; in 1861 they contained 44 per cent. In 1811 there was no town in England, except London, with a population above 100,000 ; in 1861 there were twelve such towns, containing one-quarter of the people. To illustrate the extent to which the increasing population of London was fed by the rural districts, it was mentioned that out of eleven persons over the age of twenty in London, six were born in the country.

Statistics and charts were then produced, illustrating infant and adult mortality. Four populations were compared : that of England as a whole ; of Liverpool: of ten cotton manufacturing towns of Lancashire and Cheshire, not including Manchester; and of seven purely agricultural counties. These populations were compared: first, with respect to their rate of mortality at the infantile period; secondly, at the reproductive period; the mortality in the case of women being examined at successive periods from 15 to 45; in the case of men, from 25 to 55. It was shown that in both periods the rate of mortality in Liverpool and the cotton districts was far above the rate for England at corresponding times; that of the agricultural districts far below it. Attention was also called to the fact, that in towns where women were largely employed in factories, their mortality relatively to men of the same age was far beyond what it should be, taking the standard of England as a whole.

March 5, 1869.—William Huggins, Esq., F.R.S., on "Some Further Results of Spectrum Analysis as applied to the Heavenly Bodies."

The speaker said that four years ago he had the honour to give in the theatre of the Royal Institution an account of the results of an attempt to apply the method of analysis by the prism, for which science is indebted to Kirchhoff, to the light of the heavenly bodies. It was the speaker's purpose to describe, on the present occasion, some of the results which had been obtained in his observatory since the spring of 1865. The peculiar suitability of spectrum analysis as a mode of investigation of the bright objects in the heavens had been confirmed, not only by the gain of further information of the chemical and physical constitution of some of these immensely distant bodies, but also by knowledge of another kind which this elegant and searching method of analysis had revealed to us.

1. *A continuous spectrum without dark or bright lines* shows, as a general rule, that the luminous source is in the solid or liquid state. In certain exceptional cases, however, a gas may give a spectrum which is apparently continuous. Dr. Balfour Stewart pointed out that as gases and vapours possess a power of general absorption, in addition to the selective absorption peculiar to each gas, a gas when luminous would emit light of all refrangibilities, producing a continuous spectrum, in addition to its spectrum of bright lines, and further that the intensity of this continuous spectrum would be in proportion to the opacity of the gas. The researches of Plücker and Frankland have shown that under certain conditions of density and temperature, the bright lines of hydrogen expand so as to produce a spectrum which is apparently continuous.

2. *A spectrum of bright lines* indicates that the luminous body is in the state of gas. Each gas and vapour has its own set of lines. The lines may be greatly modified, or even altogether changed, under different conditions of temperature and density, as is well known in the case of nitrogen, the vapour of sulphur, and some other substances; but throughout all these changes each gas behaves in a way peculiar to itself. There appears to be one exception to the statement that a spectrum of bright lines is peculiar to luminous gas. Bunsen found that when solid erbia is heated to incandescence, the continuous spectrum contains bright bands.

3. *A continuous spectrum interrupted by dark lines* informs us that the light has passed through vapours at a lower temperature than the source of light. As the kinds of light absorbed by each vapour correspond precisely with the set of bright lines which that vapour emits when in the luminous state, it is possible to learn if the vapours are those of any of the substances with which we are acquainted.

Under certain conditions the spectrum of a luminous body is adapted to tell us whether that body is moving towards or from the earth. The importance of information on this point will be seen from the consideration that the proper motion of the stars represent that part only of their whole motion which is transverse to the line of sight; for any motion they might have in the visual direction, towards or from the earth, would not cause any visible displacement of the star, and could not therefore be ascertained by the ordinary methods of observation.

Of all the stars which the speaker had compared with terrestrial elements, when working with his distinguished friend Dr. W. A. Miller, Treas. R.S., Sirius, which contains four very strong lines which are due to hydrogen, appeared the most suitable for this investigation. The apparatus employed, and the special precautions which were taken to ensure the perfect coincidence in his instrument of the stellar lines with those of the substance compared with it, were described by the speaker, who stated that after a prolonged comparison, extending over many weeks, of the line of hydrogen in Sirius in the green, at the place of F in the solar spectrum, with the line of terrestrial hydrogen, he found that the line in the star had undergone a shift in the spectrum equal to a difference of wave length, which would correspond to a motion of recession between the star and the earth of 41 miles per second. The speaker had obtained evidence from experiment that this shift was not due to unsymmetrical expansion of the line in hydrogen as the density is increased. The greater width of this line in Sirius than in the solar spectrum would show that the hydrogen in Sirius, though at a pressure considerably less than that of our atmosphere at the surface of the earth, is more dense than the hydrogen in the solar atmosphere by which the dark line F is produced. This conclusion is in accordance with the presumably enormous mass of Sirius, as suggested by its great intrinsic splendour.

The speaker then described some observations of the sun. He found that while the solar lines are for the most part thickened when viewed in the light from the umbra of a spot, the lines C and F due to hydrogen did not appear to be altered. This observation is of interest in connection with the constitution of the solar prominences as shown by the observations of the great eclipse of last August. The speaker nearly three years ago, at the same time that he had independently made attempts to see the prominences by means of the spectroscope, also tried the method of using absorbing media, by which the parts of the spectrum where the bright lines occur might remain, while all the rest of the spectrum was extinguished. In this way the faint prominences would be rendered visible, in consequence of the much greater relative diminution of the intensity of the illuminated screen of air, which on ordinary occasions conceals them from view. Recently he had succeeded in viewing the outline of these objects by means of a coloured glass combined with a spectroscope with a wide slit. He expected to be able to view these objects by means of coloured media alone.

## LONDON ASSOCIATION OF FOREMEN ENGINEERS.

The monthly meeting of this Association took place on Saturday, the 1st ult. at the City Terminus Hotel. Mr. J. Newton, of the Mint, President, and Mr. J. Briggs, filled the chair and deputy chair. The election of new members constituted the first business of the sitting. Among the honorary associates chosen unanimously on this occasion were J. Clark, Esq., chief engineer of the Peruvian navy, and Alexander John Dudgeon, jun., Esq. ; Messrs. W. Price and W. Fothergill were elected as ordinary members ; and Messrs. F. Jordan, S. Goddard, and T. Hooten were nominated as candidates for the same position.

Mr. James Rae read a paper on " Iron Shipbuilding as it Was, Is, and Ought to Be." The author's remarks were confined to ships built for peaceful and commercial purposes. Were those vessels constructed so as to ensure the maximum amount of safety to passengers and property ? He answered that at present most decidedly they were not. Iron ships, as a rule, were built with frames of that metal, the outer skin being formed of plates of iron and the inner one of timber planking. This latter served as a floor for the reception of the cargo, but it was no safeguard in the event of the outer skin being penetrated. Bulkheads were, in ninety-nine cases out of the hundred, illusory and deceptive protectors of iron ships. The author of the paper stated some startling facts which had come under his own notice when engaged as manager for a large shipbuilding company, and which demonstrated very forcibly the haphazard modes of construction commonly practised not many years since. Mr. Rae also took some credit to himself for remedying the evils to which he referred, and especially considered himself entitled to commendation for having been the first to introduce the plate-planing machine into the shipbuilding yard. This apparatus was now almost universally employed instead of, or as supplementary to, the shearing machine, and Lloyd's rules distinctly specify that all " butts" shall be planed.

In 1858 the author commenced an improved system of connecting the stem and stern of vessels with the kelson. The kelson plate was, in reality, carried up the stem and stern to a considerable height, and the solidity of the vessel was thus increased three-fold. The Admiralty had, it appeared, adopted the scheme without recognising its promoter. Mr. Rae was of opinion that all iron vessels ought to be built with an internal as well as an external iron skin, the latter, of course, being of the greater thickness. Both should be made perfectly watertight. Between the inner and the outer skins a series of bulkheads (say 9ft. apart), and extending from gunwale to gunwale, should be affixed. The spaces between the bulkheads should be filled in with asphalte, so as to prevent water passing from one space to another. Such an arrangement would add but little to the original cost of the ship, whilst it would increase her strength fully 50 per cent.

Mr. E. J. Reed, C.B., Chief Constructor of the Navy, commenced the discussion which followed the paper. He considered that the Admiralty had not acted unfairly towards the reader of the paper. That gentleman had, no doubt, discovered the weak points to which he had referred in regard to the stems and sterns of the older iron ships, but so had many others, and it was hardly to be expected that so self-evident an improvement could come under the prohibitory provisions of letters patent. For himself (Mr. Reed) he had a dislike of patents generally. As to the double-skinned vessel with " asphalte" filling between the bulkheads, he had little faith in it. The ship in such case would be permanently loaded very much to her detriment, whilst the contingent advantage was problematical. He wished also to say that in every instance where bulkheads were used in the Royal Navy, their water-tight qualities were tested by hydraulic pressure.

Mr. Wearing combated some of the propositions of Mr. Reed.

Mr. Vinicombe defended the Government from the charges made against it.

Mr. Campbell followed in the same direction, and cited cases where compensation had been awarded for valuable communications.

Messrs. Stabler, Taylor, Clark, Ives, Walker, the chairman, and others, continued the discussion, and, finally, a vote of thanks was unanimously awarded to Mr. Rae, who, in returning thanks, took occasion to reply to some of the objections of Mr. Reed and others who had differed with his (Mr. Rae's) propositions. At a late hour the sitting terminated.

## INSTITUTION OF MECHANICAL ENGINEERS.

The general meeting of this Institution was held, April 29, in the Lecture Theatre of the Midland Institute ; Sampson Lloyd, Esq., Vice-President, in the chair.

The first paper read was a " Description of Guibal's Ventilating Fan, employed at the Homer Hill Colliery, Cradley," by Mr. James S. E. Swindell, of Stourbridge. The fan has eight vanes, and revolves on a horizontal shaft within a cylindrical casing of brickwork, by which it is completely enclosed at the sides and circumference, with the exception of a circular aperture in the centre of one side for the entrance of air from the mine, and an outlet opening in the circumference for the discharge of the air into the outlet chimney. The area of the outlet opening is regulated by an adjustable sliding shutter, according to the extent of ventilation required; and the outlet chimney is built with a gradually increasing area up to the top, so as to reduce the velocity of the air at the point of discharge, and thereby

prevent the loss of power that would occur in discharging it at the velocity of the fan. The fan is driven direct by a horizontal steam-engine, working a crank on the end of the fan shaft, without the intervention of any gearing. The fan is 16½ feet diameter and 4¾ feet width, and its usual working speed is twenty-six revolutions per minute, discbarging 13,500 cubic feet of air per minute. This is the first mechanical ventilator that has been applied to the working of the South Staffordshire Thick or Ten-Yard Coal ; and it has now been running about nine months, without a single stoppage for repairs of any description, and is doing excellent work, the total cost of the fan, with engine and connections, being only about one-third of that of an ordinary ventilating furnace for producing the same amount of ventilation.

The next paper was a "Description of the Steam Road-Roller used in Paris," by Mr. E. Gellerat, of Paris, communicated through Mr. George Heaton. This roller consists of a locomotive engine carried entirely upon two large cast-iron rollers of eqnal size, which are both driven by the engine, the course of the machine being controlled by a special arrangement for changing the direction of the roller axles. The result is that the whole of the weight of the machine is made available both for the rolling of the road and for propelling the machinc. The engine is capable of being readily started in either direction without any slipping, and can easily round very sharp curves. These machines have now been in regular use in Paris for four years, and the results of their working have so thoroughly established their durahility and economy that they are used for the whole of the roads in that city and the suburbs. The machine has a longitudinal wrought-iron frame, like a locomotive engine, with cross bearers to carry the boiler, and a water tank at the hack of the footplate. The two large carrying rollers are 3 feet 10 inches in diameter and 4 feet 7 inches in length. They are cast-iron cylinders of 1½-inch thickness, with intermediate strengthening ribs and internal flanges at the ends, to which wrought-iron plate covers are fixed. These close the two ends of the rollers, and have cast-iron bosses in their centres for bearings on the axles. The axles are stationary, and the rollers revolve round them with bearings extending the whole length of the roller, and consisting simply of a cast-iron cylinder, with a continuous bearing on the avle, and furnished with a spiral groove for lubrication. One end of each roller has a manhole in it, giving access to the interior for oiling the bearings. Tbere are two sizes of these machines used in Paris—one weighing fifteen tons, and the other thirty tons, in average working order. The machines are hired at a fixed charge, which is regulated by the weight of the machine and the distance run in work ; the rate being per ton per mile of the machine 7*d.* by day and 8*d.* by night. This rate includes all expenses of wages, coals, and materials for working and repairs, excepting the supply of water, which is furnished by the municipal authorities. The work of each machine is measured by a self-acting counter, indicating the distance travelled, measured at the mean diameter of wear of tbe rollers ; the measurement of distance being taken only during the actual time of rolling, with an allowance added of three miles for travelling to and from the place of work. The work is, as a general rule, done in the night within the city, the portion of road repaired during a night being completely finished by the morning, ready for traffic. The speed of working is from 1½ to 2½ miles per hour, being limited to the latter amount by the public regulations. The usual practice in repairs is to lay down a layer of broken stone about 2½ inches thick at the sides of the road, and 6 inches thick in the middle; the surface of the road being generally picked up previously. The rolling engine commences work at tbe opposite sides of the road ; alternately travelling backwards and forwards over a length of about 100 yards, and working its way gradually to the middle of the road, when it proceeds to roll anotber similar length. The layer of broken stones is watered from the street mains, and binding material, consisting of road scrapings, is put on before the rolling. There is not the slightest difficulty experienced in reversing the motion of the rolling engines, and they start in either direction without any slip whatever, and the broken stone is regularly rolled down without getting pushed up or driven before the rollers. In making new roads the broken stone is usually laid down in a single layer of ten to twelve inches in thickness, and this thickness of material can be satisfactorily rolled. The total distance travelled per day of ten working hours by one engine is usually from fifteen to twenty miles. In working, two men are employed for the smaller engines, an engineman and a steersman ; and for the larger engines a fireman in addition, for the purpose of oiling upon the road without stopping the engine. In reference to the relative cost of rolling roads by the steam roller or by horse-power the following facts may be taken as a comparison of the prices per ton per mile by each plan. The result of numerous data shows the cost of horse-rolling in Paris (including horse keep, drivers, and oiling) to be 11*d.* per ton per mile ; or about 11¾*d.* including cost of repairs. The addition of interest of capital and depreciation would raise the total cost to about 14*d.* per ton per mile. On the other hand, for the steam-rolling the actual payment is only half that amount, or 7*d.* per ton per mile, including the contractor's profit; so that there is a great economy as regards cost of power in the steam roller. The advantages of the steam roller over those drawn by horses are economy in the cost of the work, rapidity of execution, and greater perfection in the work done ; the durability of the road surface being found to be at least doubled where the steam-rolling has been well done, as compared with roads not so rolled.

The meeting then terminated.

## INSTITUTION OF CIVIL ENGINEERS OF IRELAND.

Thirty-third Annual Meeting, 1869.—Report of Council states that the following papers were read before the Institution during the past session :—

Jan. 8th, 1868.—On the Repairs of the River Wall at Burgh Quay, Dublin. By Isaac J. Mann, Member.

Feb. 12th, 1868.—Description of an Experiment on the Strength of a Lattice Girder at the Boyne Viaduct. By B. B. Stoney, Member.—On the Prismoidal Formula. By E. Townsend, Member. Communicated through B. B. Stoney, Member.

April 8th, 1868.—On Anderson's Patent Selecting and Locking Apparatus for Railway Signals. By John Bailey, Member.

May 13th, 1868.—Description of the Failure of a Lattice Girder near Longford. By James Price, Vice-President.

Dec. 9th, 1868.—On the Method of Preventing the Bursting of Domestic Water Pipes by Frost or Pressure. By G. H. Kidd, M.D.—On a Self-acting Regulator for the Supply of Water at High Pressure. By Charles Geoghegan, Associate.

The following members have been added since last report :—James Kennan, Edward Stoney, Howard Grubb, Clement Dunscombe, James Thomson, M.A.

# MONTHLY NOTES.

Gunnery.—An explosion occurred in the shell foundry, Royal Arsenal, on the evening of the 11th March last, about 8 P.M., in a part of the building where shells are dipped in molten lead to remove the lead adhering to them. In one shell returned into store from Bull's Point there was some powder, and it had not been long in the molten lead before it exploded, scattering its fragments and the lead in all directions, and injuring three men.

A suspension of the manufacture of the Palliser chilled shot has been ordered in consequence of a report made from Shoeburyness of the breaking of several of them in the bore of the gun when fired. It appears that the stud or bouche at the sides near the bottom of the shot are forced in by the explosive power of the powder, which breaks and destroys the missile, and until this defect can be remedied no more will be made.

The following characteristic letter has appeared :—

Colonel Campbell and Mr. Fraser have reason to congratulate themselves on the complete success which has attended the bold revolution inaugurated by them upon the older methods employed at Woolwich for producing "ringed guns," and scarcely need the tardy congratulations of one, whose efforts, in the interest of his own plans, which have proved so useless and abortive, have been persistently employed to damage and obstruct their endeavours.

### THE WOOLWICH GUNS.

TO THE EDITOR OF THE TIMES.

Sir,—In a letter which I addressed to the *Times* on the 4th of January last I expressed the opinion that the heavy Woolwich rifled guns would burst with violence in the event of the inner tube being cracked.

A 9-inch Woolwich gun has just concluded a long test for endurance, and, towards the end of the trial, the inner tube became cracked. The gun has, since that occurrence, fired a considerable number of battering charges without bursting.

My opinion was founded upon the bursting, at proof, of one of these guns, but the above experiment, combined with the numerous proofs of other guns, shows that there must have been something exceptional in the construction of the gun which burst, and I am therefore anxious to acknowledge that I was mistaken in my belief.

The national importance of the result of this experiment cannot be exaggerated; it proves that the 9-inch rifled guns with which the Navy is chiefly armed, and about the safety of which others besides myself had entertained doubts, are fully strong to fire 55lb. charges, which would enable them to penetrate any ironclad in existence.

While congratulating Colonel Campbell and the officials in the Royal Gun Factories, as well as the late Ordnance Select Committee, I trust I may state that, although I am the projector of a rival gun, no one can be more pleased than I am at the result of the trial.

I am, Sir, your obedient servant,

Army and Navy Club, May 3rd. W. Palliser.

It is a remarkable phenomenon—which possibly some of the "authorities" could throw some light upon—that whenever "the Liberals" are in power, Mr. Whitworth's inventions are successful beyond precedent. Whenever there is a Tory ministry, Major Palliser's take Nature by storm; Nature herself surely must change her politics, if not her laws.

The following notice gives sufficient details of the trials as to endurance to which Major Palliser's letter refers :—

### ENDURANCE OF THE WOOLWICH GUN.

Some time ago four guns were made to try four different systems of construction: —1, The old Armstrong pattern; 2, Fraser's modified Armstrong, with steel tube three inches thick, and over it one mass of wrought-iron, coiled and welded; 3, Fraser's also, but with a steel tube only two inches thick, the wrought-iron exterior being in two parts, the outer shrunk over the inner; 4, Palliser's heavy gun with coiled inner tube and cast-iron cast over the exterior. About 600 rounds were fired with each, and they remained sound, except the Palliser, which was cracked in the tube near the muzzle. There the experiments ceased for the time, but they are now in progress again. The guns are all of 9-inch calibre. The Fraser gun, with thin steel tube, has lately been fired another 500 rounds with battering charges, and remains perfectly serviceable. The test which it has hitherto endured is as follows :—

First 400 rounds with 30lb. charges, the vent being at the rear of the charge; then 200 rounds with battering charges of 43lb. At this stage the gun was wanted for experiments at Shoeburyness, and was re-vented for the purpose. There it was fired 14 times with 43lb. charges. Before continuing the test it was decided to do so with the vent in the service position. The gun was accordingly turned round and vented in its previous lower side. It has just completed its third series—500 rounds, this time all with 43lb. battering charges. From the commencement the projectiles have always weighed 250lb., the service weight.

The gun has, therefore, fired up to this time 400 rounds with 30lb. charges and 250 projectiles, and 714 rounds with full battering charges of 43lb. English large-grain cannon powder. This makes about 19 tons of powder and 124½ tons of

shot. The steel tube is worn at the . at of the shot, but remains in excellent condition for firing. We know of no g'. either English or foreign, of equal size, which has endured so severe a test. Indeed, it may be said that no piece of heavy ordnance is ever likely to be called upon to stand such an extraordinary trial on real service—certainly not in one war. An Armstrong gun of the Elswick pattern has fired a larger number of rounds, but not so many with battering charges of powder. We shall watch with much interest the further trials of these four guns, the representatives of English designs and manufacturing skill.

The Report of the Special Committee on Breech-Loaders.—After repeated delays the "Special Committee on Breech-Loading Rifles" for the army has made us acquainted with the result of their labours in the report recently laid before Parliament. We now merely give an outline of that report, as we hope in an early Part to discuss the merits of both the Henry and Martini weapons, and to point out wherein we consider the conclusions of the committee in regard to some points of construction appear to be remarkably erroneous. The proposed arm for the British soldier is the Martini-Henry firing the Boxer cartridge and Henry bullet. The report informs us as to the course which the competition took, the tests to which the selected arm has been subjected, and which it has satisfied, and the reasons which induced the committee to prefer it to the other systems. Taking the breech mechanism question first, it appears that the general course of the experiments to which the rifles were subjected was as follows:—The arms were carefully examined, and twenty or more shots were fired for rapidity; sand was thrown over the breech actions both open and closed, and the rifle fired without any cleaning except what could be done with the hand; three cartridges, purposely damaged to ensure an escape of gas, were fired to test the safety of the arm with imperfect ammunition. If the arm passed through these trials satisfactorily, and if the breech action appeared suitable for military purposes, it was put through a course of long-continued firing, being allowed to rust at intervals between the days of firing. The test for rapidity was not applied merely for the purpose of observing how fast the arm would fire, but as a test also for simplicity and convenience of manipulation. The sand test was intended to represent the effects of dust or sand on arms when used in dry countries, especially in India. The long-continued firing and rust tests are said to represent the ill-usage which arms in war-time may have to endure. There were sixty-five arms in all to be tried for breech mechanism. Ultimately the guns were reduced to two—the Henry and the Martini. The principal points to be considered were safety, strength, number and simplicity of parts, facility of manipulation, cost. As to safety and strength, the two appeared to be equal. As to number of parts, the Henry has forty-nine, the Martini twenty-seven. In simplicity of construction, the committee believe that the Martini has the superiority. As to facility of manipulation, both systems appear to be all that can be desired, although the absence of the hammer gives the Martini a slight superiority, and in the Henry it is reported that there is the possibility of placing the cartridge over the extractor. In cost of manufacture the Martini is stated to have the advantage. Finally, the committee prefer the spiral spring to the side lock, which, from experience and from evidence, is liable to become wood-bound. Accordingly the committee decided on giving the preference to the Martini breech mechanism. As regards the question of barrel, the report is full of interesting and suggestive matter. In the prize competition to the Henry breech action the prize was awarded in preference to the Martini, while in these trials the prize is awarded to the Martini. What turned the scale was, it appears, the cartridge. In the original trials this was bad in the case of the Martini, but in the new trials the cartridge was good—thus seeming to establish the point that no system of breech actions can be considered independently of its cartridge.

## ROYAL SOCIETY.

At the President's Soirée, Saturday April 24th, 1869, was exhibited a new arrangement of Binocular Spectrum Microscope, devised by William Crookes, F.R.S., &c., also Specimens and Spectrum Phenomena in the above Microscope, illustrating Mr. Crookes's Paper on some optical phenomena of opals.

I. This instrument has been devised to obviate the disadvantages of the ordinary Spectrum Microscope. The principal features of the new apparatus are the sub-stage and the box of prisms. The former carries a sliding plate to hold the slit and apertures, a spring stop and screws for adjusting them, and a reversed object, glass. The slit and this object-glass are about 2 inches apart, and if reflected light is passed along the axis of the instrument, the object-glass forms a very small image of the slit in front of it. A milled head moves the whole sub-stage, and screws bring the image of the slit to any part of the field. Beneath the slit is an arrangement for holding an object of irregular surface or dense substance. The stage has a concentric movement, so as to permit the object to rotate and enable the image of the slit to pass through it in any direction.

The direct vision prisms consist of three flint and two crown, fitted in a box screwed into the end of the Microscope. By means of a pin they are thrown in or out of action. The object-glass screws on in front of the prism box.

By taking the illumination from the sky or a white cloud, Fraunhofer's lines are visible, and by direct sunlight they are seen in great perfection; the dispersion is sufficient to cause the spectrum to cover the whole field, and the achromatism of the lenses being nearly perfect, the lines from B to G are practically in the same focus.

A double image prism near the slit enables two spectra to be seen, oppositely polarised, and the variations in the absorption lines are at once visible. A Nicol's prism as polariser, and another as analyser, can be connected, and these enable the brilliant colours shown by some crystalline bodies, when seen by polarised light, to be examined.

If a substance is dark-coloured, or the illumination not brilliant, the whole of the light should be passed up the tube to one eye; but when the light is good, the appearance of the spectrum, and the power of grasping faint lines, are greatly improved by dividing the light with a Wenham prism, and using both eyes; whilst the stereoscopic effect thereby communicated to some absorption and interference spectra, throws a new light on the phenomena.

By using a spirit lamp instead of the illuminating lamp, the instrument answers admirably for examining flame spectra. The characteristic yellow, crimson, or green lines are seen beautifully sharp, on introducing sodium, lithium, or thallium into the flame.

II. By means of the above-described Spectrum Microscope some curious optical phenomena of opals have been observed.

If an opal which emits a fine broad crimson light is held in front of the slit of a Spectroscope, or Spectrum Microscope, at the proper angle, the light is generally seen to be purely homogeneous, and all that is visible is a brilliant luminous line, varying somewhat in width, and more or less irregular in outline, but very sharp, and shining brightly on a perfectly black ground. If the source of light is now moved so as to shine into the spectrum apparatus through the opal, the above appearance is reversed, and we have a luminous spectrum with a jet black absorption band in the red, identical in position, form of outline, and sharpness with the luminous line previously observed.

From these and other experiments it has been found that those parts of the opal which emit red, yellow, green, or blue light are opaque to light of the same refrangibility which they emit. This is, doubtless, a general law, following, of necessity, the mode of production of the flashes of colour.

From the descriptions of the absorption phenomena of a series of opals, the following are selected as the most striking:—

No. 1 shows a simple black band in the red. When properly in focus this has a spiral structure. Examined with both eyes it appears in decided relief, and the arrangement of light and shade are such as to produce a resemblance to a twisted column.

No. 2 gives an irregular line in the orange. Viewed binocularly this exhibits the spiral structure in a marked manner, the different depths and distances standing well out; upon turning the milled head of the stage adjustment, so as to carry the opal slowly from left to right, the line is seen to revolve and roll over, altering its shape and its position in the spectrum. It is not easy to retain the conviction that one is looking merely at an absorption band in the spectrum, and not at a solid body possessing dimensions and in actual motion.

No. 9 shows a very sharp and black band stretching diagonally across the green, touching the blue at the top, and the yellow at the bottom.

No. 12 gives a narrow, straight, and sharply cut line in the green; this might easily be mistaken for an absorption band caused by an unknown chemical element.

Other opals show an absorption band travelling along the spectrum, almost from one end to the other, as the opal is moved sideways. All these black bands can be reversed, and changed into luminous bands, by examining the opal with reflected light.

The maker of the Microscope is Mr. C. Collins, 77 Great Tichfield Street, W.

Lecture Demonstrations.—Writing or figuring on a screen for Lecture purposes, by Professor Albert R. Leeds, of Haverford College, United States.

Every professor has proved how very unsatisfactory is the writing, the drawing, or any other manner of demonstrating his ideas by means of the usual board and chalk in a great hall. This difficulty may be removed in the following manner:—A glass plate is fixed into a Drummond or magnesium lamp, and a prism, which inverts the images, put on the fore part of the tube, which carries the objective. Now, if the lecturer, whilst he looks at the audience and speaks, writes on the glass plate with an ordinary quill and Indian ink in the usual way, from left to right, the writing will appear upon the screen and will be read by the hearers in enlarged letters. A coat of collodion, blackened by its exposure to the sun, can be substituted with great advantage for a simple glass plate. On such a surface chemical and mathematical formulæ can be written, drawings of apparatus, machines, crystals, anatomical sketches be made with great exactness, and will appear in distinct lines upon a black ground, in appearance similar to an immense engraving in copper.

Sulphuretted Hydrogen, the action of different bodies on, by M. Boettger. The peculiarity of the oxide of thallium, that it inflames hydro-sulphuric acid (sulphuretted hydrogen), has been acknowledged. Boettger has ascertained that other bodies act in the same manner. Without quoting all the substances tried, we may state that the gas inflames on contact with pure oxide of manganese, $Mn. O^2$, with peroxyde of lead, with peroxyde of silver obtained galvanically; with bin-oxyde of barium, (phosphuret of copper), it becomes vigorously inflamed; chlorite of lead, chlorate of silver, of soda, of potash, fulminating silver, inflame the gas, and the latter salt explodes. The ioduret of azote explodes suddenly; gun-cotton, under certain conditions, also inflames.—*Journal of the Physical Society of Frankfort.*

Movement of Water in Pipes, by M. Ganckler, Ingenieur des Ponts et Chaussées.—It is known what difficulties the theory of the movement of water, either in tubes or in the open air, presents. Notwithstanding the works of Dubrat and of Prony, and the more recent researches by MM. Davy, Dupuit, and Bazin, this interesting question is still far from being solved. With respect to the movement in pipes, M. Ganckler gives a formula which appears to be definitively adopted in practice; he states, however, that in order to express the law of the movement in open-air channels by a formula, the experiments which have been made to the present time are insufficient, especially with respect to the influence which the sides exercise dependent upon their nature. He calls attention to this important point, which can only be solved satisfactorily by the concurrence of a great number of competent men. He has obtained, in the meantime, as regards the influence of the slope of the sides of such a channel, results quite unexpected; the account of these, however, would lead us too far, but which may be found on pages 52 and the following ones of the brochure here noticed, published by Dunod of Paris.

The Electric Telegraph Schools of Instruction, 166 City Road, E.C., and 48 Warwick Street, Regent Street, W. Chief Electrician: Mr. Thomas Hood; Engineer: Mr. T. E. Lundy, C.E.—The practical working of the telegraph system is at present known to so limited an extent, that the supply of operators is greatly insufficient for the increasing demand; and it is with a knowledge of these facts that the proprietors of this establishment have opened a school at the above address, with a view of enabling young ladies and gentlemen (in separate offices) to acquire a knowledge of the practical working of the Telegraphic System as it at present exists.

There are hundreds of young ladies employed in the telegraphic services in London alone, and should the Government, as empowered by Act of Parliament passed last session, obtain possession of the telegraphs in this country, they propose to open upwards of six hundred new stations—thus creating a new and extended field for operators. Now that a general feeling exists in favour of female labour, and that the difficulty in the way of the employment of women is want of adequate training, we are glad to see that an effort is being made to remove this latter obstacle. If there is any manual occupation more suitable to women than another, it is that of telegraphy; and this, so far as the art is concerned, may now be readily learned. Of the advantages which this establishment offers there cannot be the slightest doubt, and we trust that the promoters may receive abundant support in carrying out their very praiseworthy proposal. It is stated that salaries varying from £40 to £500 per annum may now be obtained at home and on the Mediterranean stations by skilled telegraphists.

Railway Traffic.—The receipts of railways in the United Kingdom for the week ending February 28 amounted, on 13,420 miles, to £703,183, and for the corresponding week in 1868, on 13,216 miles, to £679,364, showing an increase of 204 miles and of £23,819. The gross receipts on 14 of the principal railways in the United Kingdom amounted for the week, on 9,752 miles, to £588,503, and for the corresponding week last year, on 9,576 miles, to £573,021, showing an increase of 176 miles and of £15,476. The increase on the Caledonian and North British amounted to £2,732; on the Great Eastern to £826; on the Great Northern to £779; on the Great Southern and Western to £103; on the Great Western to £261; on the Lancashire and Yorkshire to £302; on the London and North-Western to £701; on the London and South-Western to £1,003; on the Manchester, Sheffield, and Lincolnshire to £1,832; on the Midland to £6,149; on the North-Eastern to £697; and on the South-Eastern to £97—total, £15,482.

Glasgow Customs Revenue.—The amount of revenue collected at Glasgow in February was £107,363, as compared with £110,134 in February 1868, and £80,380 in February 1867. The customs revenue at Greenock in February was £113,099, as compared with £130,059 in February 1868, and £129,544 in February 1867. It will be seen that at both ports there was a falling-off in the amount of revenue, as compared with February 1868.

Australian Trade.—There was a solid recovery last year in the Australian trade, the total value of the exports made in 1868 to the Australian colonies having been £12,071,435, as compared with £9,613,739 in 1867, and £13,643,326 in 1866. The largest exports to the Australian colonies made in any one year were effected in 1853, when the value attained an aggregate of £14,513,700. In 1855, the total had sunk to £6,278,966. The total yearly value of the exports to the Australias for the last ten years has been as annexed:—1859, £11,229,448; 1860, £9,707,261; 1861, £10,692,771; 1862, £11,944,506; 1863, £12,498,534; 1864, £11,857,213; 1865, £13,339,241; 1866, £13,643,326; 1867, £9,613,739; and 1868, £12,071,435.

Bullion and Specie.—The value of gold and silver bullion and specie imported in the year 1868 was £24,852,595, against £23,821,047 in the previous year. Of the total value imported last year, £17,136,177 is returned under the head of gold, the chief portion of which was received from Australia, £6,989,594; United States, £6,976,455; and Mexico, South America (except Brazil), and West Indies, £1,252,816. The imports of silver bullion and specie in 1868 amounted to £7,716,418, of which £3,203,972 was received from Mexico, South America (except Brazil), and West Indies, £1,915,939 from the United States, and £1,045,317 from France. The value of gold and silver bullion and specie exported in the year 1868 was £20,220,014, against £21,670,687 in 1866, and £14,327,289 in 1867. Of the total value exported last year £12,708,308 is registered as gold, the chief portion of which was sent to the following countries:—viz., to France, £7,189,646; Egypt, £1,497,826; Hanse Towns, £1,094,311; and Brazil, £1,013,240. The exports of silver bullion and specie in 1868 amounted to £7,511,706, of which £1,855,253 was sent to Holland, £1,821,748 to France, £1,439,165 to Egypt, £903,669 to Hanse Towns, and £843,235 to Belgium.

Magnetisation of Iron.—M. Trève has found that molten cast-iron, surrounded by a helix through which a galvanic current is transmitted, becomes magnetic, and remains so as long as the current is maintained. Possibly it would be worth trial whether iron might not thus be separated from those of its impurities which are not similarly affected.

Petroleum as Domestic Fuel.—Although the use of petroleum as steam fuel has not proved practicable, it seems to have given excellent results applied to domestic purposes. A vapour cooking-stove, invented by Mr. Thomé, has been exhibited to the American Society for the Advancement of Science and Art. The fuel used was petroleum refuse, and the danger of explosion is obviated by the use of wire-gauze, as in miners' safety-lamps. The oven attains a baking heat in from one to two minutes, and bread, apples, and potatoes were baked, as well as a steak cooked, in the presence of the meeting. Several who had tried the stove expressed a favourable opinion as to its operation.—*Mining Journal.*

Railway Passengers' Assurance.—At the recent half-yearly meeting of this Company, it was stated in the report that the amount received for premiums in 1868 was £113,657, against £104,296 in 1867, showing an increase of 8·97 per cent. The total receipts in 1868 were £117,086. The number of general accident policies in 1868 was 40,996, and in 1867 38,576, showing an increase of 2,420. The amount paid as compensation for accidents during the year was £62,200, being at the rate of 54·72 per cent. of the premiums. There were 29 claims for fatal accidents, amounting to £17,297, and 3,195 claims for non-fatal accidents, amounting to £44,903. The working expenses were 28·84 per cent. in 1867, and 28·20 per cent. in 1868. The balance to credit of revenue on the 31st of December last was £61,081, out of which the directors proposed to pay a bonus of 14*s.* per share, one-half of which would be credited as paid up on each share, and the remaining 7*s.* per share would be paid in cash, in addition to the usual interest at the rate of 6 per cent. per annum for the half-year on the capital paid up. The invested capital and reserve fund amounted to considerably more than £80,000.

Prooness of Shipbuilding on the Clyde.—R. Duncan and Co., of Port Glasgow, have contracted to build a screw steamer of 1,000 tons for Mr. R. Little, of Greenock. Messrs. Randolph, Elder, & Co. have launched the Patagonia, a vessel of 3,000 tons burden, builders' measurement, and 600-horse power nominal. The Patagonia has been built to the order of the Pacific Steam Navigation Company, and is a sister ship to the Magellan, lately launched by Messrs. Randolph, Elder, & Co.; she is intended for the company's direct mail line between Liverpool and Valparaiso. Her engines, which are being supplied by Messrs. Randolph, Elder, and Co., are constructed upon their patent compound principle. Messrs. R. Duncan and Co., of Port Glasgow, have launched an iron screw named the Cambria, of the following dimensions:—Length, 315ft.; breadth, 35ft.; depth, 22ft. 6in.; burden, 2,000 tons. The Cambria will form one of the Anchor Line from Glasgow to New York. Messrs. W. Hamilton and Co. have launched from their yard at Port Glasgow a paddle named the Osmanhy, built for the Ottoman Government. The Osmanby, which is a strongly-built wooden steamer, is of the following dimensions:—Length, 178ft.; breadth, 21ft.; depth, 10ft.; and burden, 370 tons.

Metropolitan Board of Works.—A return recently published shows the sums expended upon the several works since the establishment of the Metropolitan Board of Works. From this document it appears that the total expenditure has been rather over twelve millions and a quarter sterling. The chief expenditure has, of course, been on account of the metropolis main-drainage, the total sum spent up to the 1st of July last being £3,967,184 9*s.* 3*d.* The cost of the main sewers and ordinary expenses up to the same date amounted to £3,178,716 5*s.* 7*d.* The sum charged to the Thames Embankment account, North, was £1,599,052 14*s.*; South, £846,010 7*s.* 4*d.*, while the cost of Mansion-house Street was £1,264,611 11*s.* 1*d.* The maintenance of the Fire Brigade accounts for the expenditure of £172,482 15*s.*

English Machinery in Siam.—English machinery is being largely employed by the natives of Siam. The Siamese dockyards are busy building and repairing steamers; iron bridges have been erected over some of the creeks; gas-works constructed in the palaces of the king and prime minister; two steam dredges put together and set to work; and another steam rice-mill added to the four large mills already existing. A large sugar-mill and distillery, a saw-mill, British shipyard and dry-dock, have been in operation since the beginning of 1867; and as the supplies for all these come almost entirely from England, there must be a very considerable export of British machinery going on to the East.

The Tinning of Saucepans.—In France, as in other parts of the Continent, the use of copper saucepans is more general than it is in England, and great care is generally taken to keep them in good order. In all well-conducted houses copper vessels are tinned frequently, and cooks are thoroughly impressed with the danger accruing from neglect in this respect. The police regulations require that nothing but pure tin should be used, but that metal is dear while lead is cheap, and therefore a mixture of the two metals is too often made use of. The mixture works well, but when the lead forms a considerable part of it the vessels become decidedly dangerous. In consequence of information obtained and suspicions entertained, the Minister of War ordered an inquiry to be made into the subject by the directors of the military hospitals. The result of this inquiry has been read before the Academy of Medicine, and brings out the fact that some manufacturers and tinners of copper utensils mix 25, and in some cases 50 per cent. of lead with the tin, and that, in addition to this, antimony, another dangerous metal, is sometimes present. From the facts thus brought to light, M. Goblev, a member of the Academy of Medicine, has drawn up the following list of recommendations:—1. That the metal used to line copper drinking vessels shall not contain more than 1 per cent. of lead; 2. That not more than 5 or 6 per cent. of lead be mixed with the tin used for saucepans or other cooking vessels, that amount offering no serious danger; 3. That every maker shall be required to mark his productions with a special stamp; 4. That the travelling tinmen shall be strictly watched.

Great Reservoir of Montrouge, Paris.—Another great reservoir for the supply of water to Paris, and similar to that at Ménilmontant, is being constructed to receive the waters of the Vannes, which are being brought to Paris by means of aqueducts. The new reservoir is situated close to the new park of Montsouris, not far from the railway station of the Sceaux line. This reservoir will contain more than 67,000,000 of gallons, for the supply of the left bank of the Seine, and such portions of the city on the other side as are not supplied from other sources. The object of the reservoir being built in two stories is to obtain a pressure sufficient to supply the houses in the highest parts of the town. Two more artesian wells are also being pierced; one, at La Chapele, is to be 900 mètres deep, and half this depth is already attained, but it will take at least two years' more labour to complete the work; the other is at a spot called the Butte aux Cailles, near the Place d'Italie; but so many difficulties have occurred that the work will not be concluded for several years. Amongst the decorations of the new park of Montsouris, the most conspicuous will be the palace of the Bey of Tunis, first erected in the grounds of the Universal Exhibition of 1867; it will be taken down and reconstructed exactly in the same manner, only the lower portion will be built of hewn stone instead of ashlar.

Scally's Paraffin Process.—This consists in a peculiar method of coating the inside of casks with a very pure and highly-refined paraffin, which forms an impervious coating, that not only prevents loss by evaporation of the contents of the cask, but also enables brewers to use any otherwise foul cask without fear of any bad effect to the beer, as the paraffin gives an entire coating to the cask, making it in many respects better than a new one. The process is likely to prove extremely useful, not only to the brewing trade, but also to wine-growers, vinegar-makers, &c., as neither alcohol nor strong acids affect the coating. The patent is in the hands of Messrs. Coleman & Co., of 13 St. Mary-at-Hill, E.C.

A New Alloy.—A new alloy, forming, we are told, a beautiful white metal, very hard, and, capable of taking a brilliant polish, is obtained by melting together about 70 parts of copper, 20 of nickel, 5½ of zinc, and 4½ of cadmium. It is, therefore, a kind of German silver, in which part of the zinc is replaced by cadmium. This alloy has been recently made in Paris for the manufacture of spoons and forks, which resemble articles of silver.

APPLICATIONS FOR

# PROVISIONAL PROTECTION FOR INVENTIONS

## UNDER THE PATENT LAW AMENDMENT ACT.

☞ When the city or town is not mentioned, London is to be understood.

*6th April* 1869.

1033 G. T. Bousfield, Brixton—Paper and sizing.—A com.
1034 G. T. Bousfield, Brixton—Shafts and other parts of carriages.—A com.
1035 F. F. Villepigue, Northumberland Street—Boring rock or other material
1036 A. Helwig, Old Kent Road, Kent—Stitching and button-hole sewing-machine
1037 J. M. Johnson, Maida hill—Lavatories
1038 E. O'Brien, Liverpool—Beam balance for weighing grain
1039 R. B. Hooper, T. Nickson, and H. R. Nickson, Liverpool—Fastening and applying wood-sheathing to ships
1040 A. V. Newton, Chancery Lane—Baking oven.—A com.
1041 A. K. B. Granville, Sandford-on-Thames, Oxford—Beating engines for the manufacture of paper

*7th April* 1869.

1042 W. Goodreds, Tipton, Stafford—Furnace doors for puddling furnaces
1043 J. Mason, Birmingham—Breech-loading guns
1044 W. T. Rickard, Threadneedle Street—Cements
1045 R. Norfolk, Beverley, York—Casting screw threads on the naves of wheels
1046 G. S. Chase, Belfast, Antrim—Combustion of gas
1047 E. Collard, Bloomsbury—Dress improvers.—A com.
1048 W. E. Gedge, Strand—Ventilating apparatus.—A com.
1049 H. B. Barlow, Manchester—Caskets for jewels.—A com.
1050 W. R. Lake, Southampton Buildings—Permanent way of railways.—A com.
1051 J. Menzies and J. Menzies, Perth, N.B.—Shuttles
1052 J. H. Teale, Leeds, York—Putting on or taking off boots or shoes
1053 B. McEvoy, Birmingham—Game for out or indoor exercise
1054 J. Robbins and J. Allbut, Tipton—Pumps
1055 W. Powell, Birmingham—Breech-loading firearms
1056 W. H. Douglas, Stourbridge, Worcester—Glove fasteners
1057 W. H. Douglas, Stourbridge, Worcester—Sleeve link or solitaire
1058 G. Ashcroft, Alexandria, Egypt—Hydraulic presses
1059 W. H. Balmain, St. Helens, Lancashire—Oxidizing agents for bleaching
1060 L. Mond, Farnworth, Lancaster—Utilising products from soda and potash waste
1061 W. E. Newton, Chancery Lane—Steam generators.—A com.
1062 W. T. Eley, Gray's Inn Road—Cartridge cases for breech-loading firearms
1063 C. E. H. C. Healey, Strand—Cleaning breech-loading firearms

*8th April* 1869.

1064 J. W. Warman, Farringdon, Berks—Manuals of organs
1065 J. I. Stassen, Euston Road—Velocipedes
1066 A. H. Brandon, Rue Gaillon, Paris—Joining leather and rendering it impermeable.—A com.
1067 H. Parslow, Glasgow, N.B.—Designing the forms of articles of apparel
1068 A. Stewart and J. Wotherspoon, Coathridge, N.B.—Cutting metal tubes, pipes, bars, or similar articles
1069 R. W. Munro, Clerkenwell Green—Markers for whist
1070 J. Pattinson, Newcastle-on-Tyne, Northumberland—Utilising the ammoniacal skimmings obtained in galvanizing iron
1071 D. Hallas and G. Hallas, Leeds, York—Regulating the supply and purifying gas
1072 J. A. Chanfourier, Paris—Self-feeding cotton gin
1073 A. Fryer, Manchester—Production of sugar from sugar-cane or beetroot
1074 W. T. C. Pratt, Newport, Monmouth—Signalling on railways

*9th April* 1869.

1075 G. D. Hughes and A. H. Sellers, Nottingham—Safety-valves
1076 J. Aspinall, Harrow—Telegraphic cables
1077 W. A. Hunter, Southport, Lancaster—Lighting street lamps
1078 T. Culpin, Reading, Berks—Reaping machines
1079 J. A. Miller, New York, U.S.—Boilers, and removing sediment
1080 J. Denis, Paris—Cutting cogs without displacing the wheel
1081 R. J. Morison, Mark Lane—Presses for cotton, wool, and plastic substances.—A com.
1082 R. J. Colls and A. E. Bull, Reading, Berks—Fastenings for boots
1083 J. Dewar, Kirkcaldy, Fife, N.B.—Food and manure
1084 C. J. F. Campbell, Camberwell—Hanging pictures
1085 C. Lungley, Greenwich, Kent—Removing deposit from tubes
1086 W. W. Hooper, Bow, and J. D. Hooper, Woodford—Vehicles
1087 W. E. Newton, Chancery Lane—Motive power for driving various kinds of light machinery.—A com.
1088 A. V. Newton, Chancery Lane—Rotary engines, pumps, and meters.—A com.
1089 T. H. Blamires, Huddersfield, York—Apparatus for receiving votes at elections
1090 W. R. Lake, Chancery Lane—Waterproof paper fabrics.—A com.
1091 P. Jensen, Finsbury Square—Pumps.—A com.

*10th April* 1869.

1092 H. W. Lobb, Piccadilly—Velocipede
1093 S. F. Van Choate, Boston, U.S.—Firearms
1094 E. Brasier, New Cross, and J. E. Hodgkin, West Derby, Lancaster—Scutching flax
1095 W. Smith, Heywood, Lancaster—Looms
1096 H. A. Bonneville, Piccadilly—Sewing machines.—A com.
1097 W. Ashton and J. H. Storey, Manchester—Indicating the "duty" of steam-engines
1098 J. Hynam, Deptford, Kent—Crucibles and other hollow articles
1099 J. M. Hetherington, Manchester—Combing cotton
1100 J. B. Spence, Manchester—Treatment of cast-iron for conversion into malleable
1101 P. Headridge, Manchester—Dentistry
1102 D. B. Peebles, Edinburgh—Gas-meters
1103 E. C. C. Stanford, Glasgow, N.B.—Deodorizing solid, liquid, and gaseous matters
1104 G. Haworth, H. Hanghton, and R. Gibbons, Blackburn—Facilitating the consumption of smoke
1105 O. Vivier, Sekforde Street, Clerkenwell—Escapements for watches
1106 J. H. Johnson, 47 Lincoln's Inn Fields—Removing hair from skins.—A com.
1107 J. Parry and R. Morris, Llanberis—Saws for cutting slate or other materials
1108 E. T. Hughes, Chancery Lane—Sewing or stitching.—A com.
1109 W. Martin, Manchester—Ships and vessels
1110 L. J. Crossley, York, and R. Hanson, Halifax—Valves
1111 J. Wadsworth, Manchester—Lighting fires
1112 D. Johnson, Wrexham, Denbigh—Manufacturing flour
1113 J. H. Dales and J. F. Maygrove, Wood Street—Looms for weaving
1114 A. M. Clark, Chancery Lane—Fountain pens.—A com.

*12th April* 1869.

1115 W. Crombleholme, Manchester—Registering persons entering and going out of public vehicles and buildings
1116 E. D. Temple, King William Street—Railway signals
1117 J. Kirk, Woolwich—Cabs or other vehicles
1118 S. F. Shore, Uttoxeter, Stafford—Propelling railway carriages
1119 J. Easton, Taunton, Somerset—Drop drills.—A com.
1120 W. R. Lake, Chancery Lane—Railway.—A com.
1121 E. Beanes, Maidenhead, Berks—Brewing
1122 A. d'Azambuja, Joinville-le-Pont, France—Felted fabrics

*13th April* 1869.

1123 H. Browne, Liverpool—Velocipedes
1124 C. D. Abel, Chancery Lane—Aërial navigation.—A com.
1125 S. Holman, Laureuce Pountney Lane—Velocipedes
1126 T. F. Cashin, Old Broad Street—Indicators in connection with switches or points on railways
1127 T. B. Burns, Camelford, Cornwall—Cases to be employed with breech-loading firearms
1128 W. Brock, Glasgow, N.B.—Slide valves
1129 J. Roberts, Birmingham—Draw-plates or fire hasteners
1130 C. Turner, Southampton—Cowls for chimneys and shafts
1131 B. J. B. Mills, Southampton Buildings—Boots and shoes.—A com.
1132 R. E. Marshall and C. Marshall, Cheltenham, Gloucester—Distributing fumigating matter
1133 W. Gillespie, Plumstead, Kent—Furnace bars
1134 W. E. Newton, Chancery Lane—Joints for rails.—A com.
1135 A. V. Newton, Chancery Lane—Fan blower.—A com.
1136 J. H. Johnson, Lincoln's Inn Fields—Compound telegraph wire or conductors.—A com.
1137 F. Erskine, Manchester—Fire-bars
1138 J. H. Johnson, Lincoln's Inn Fields—Dental wash.—A com.
1139 M. Samuelson and C. Eskrett, Kingston-upon-Hull, York—Envelope and filling plate to be used in expressing oil
1140 J. Leechman, Hammersmith—Steam-engines.—A com.

*14th April* 1869.

1141 E. Dowling, Saint John's Wood—Pianoforte actions
1142 J. Chandler, Mile End Road—Drawing and preventing waste of water
1143 P. A. Blake, Highbury—Safety explosive compound
1144 A. H. Renton, Westminster—Jointing pipes and tubes
1145 W. H. Hacking, Thomas Hacking, and J. Chambers, Bury, Lancaster—Sizing warps, weaving, and folding or plaiting fabrics.—Partly a com.
1146 G. Keighley, Burnley.—Velocipedes
1147 J. McLaughlan, Greenock, N.B.—Retorts for re-burning animal charcoal
1148 T. Atkinson and R. Smith, Preston, Lancaster—Indicators for indicating the distance travelled by vehicles
1149 J. Whitley and S. J. Peet, Leeds, York—Moulds and cores for casting metals
1150 B. W. Farey, Bermondsey—Steam-engines
1151 W. Wright, Mostyn—Treating ores
1152 J. H. Johnson, Lincoln's Inn Fields—Burning liquid hydrocarbons.—A com.
1153 J. G. Jennings, Stangate, Lambeth—Building blocks
1154 T. White, Birmingham—Nut and lobster crackers
1155 W. Gradwell, Manchester—Steam-boilers
1156 C. T. Swanston, Twickenham—Enabling railway trucks and carriages to be drawn by horses or traction-engines
1157 A. M. Clark, Chancery Lane—India-rubber nipples for feeding-bottles—A com.
1158 C. E. Broomau, Fleet Street—Burning liquid hydrocarbons.—A com.
1159 C. E. Brooman, Fleet Street—Producing motive power.—A com.
1160 H. J. Worssam, City Road—Lifting casks or packages
1161 G. Black, Grantham, Lincoln—Agricultural drills
1162 W. H. Buck, Stretford, Manchester—Velocipedes
1163 E. Cooper, Laurence Pountney Lane—Waterproof coats
1164 R. Heyworth, Manchester—Water-closets
1165 A. W. C. Williams, Connecticut, U.S.—Bottles
1166 F. J. Bramwell, Great George Street—Steam-engines and furnaces
1167 J. Vivian, Falmouth, Cornwall—Engines, pumps, and machinery for mining
1168 A. M. Clark, Chancery Lane—Compasses and pen and pencil-cases or holders.—A com.
1169 J. H. Johnson, Lincoln's Inn Fields—Motive-power engines and steam generators.—A com.
1170 W. J. Cowlman and A. Doe, New Windsor—School desks, tables, and seats
1171 A. K. Rider, New York, U.S.—Valves and valve gear

*16th April* 1869.

1172 F. Mulliner, Northampton—Wheeled carriages
1173 L. Eggert, Konigsberg, Prussia, and O. E. Pohl, Liverpool—Vessels of war
1174 F. F. Whitehurst, Putney, Surrey—Mashing grain and obtaining products
1175 R. Legg, Clerkenwell—Spinning and winding tobacco
1176 W. H. Thick, Kentish Town—Fret-cutting machines
1177 S. Harrison, Liverpool—Ventilating and flushing sewers
1178 G. T. Bousfield, Brixton—Hydrocarbon oils.—A com.
1179 A. F. Craig, Paisley, N.B.—Dividing pasteboard to form cards
1180 J. H. Johnson, Lincoln's Inn Fields—Firearms and sights.—A com.
1181 W. E. Newton, Chancery Lane—Burners for explosive gases.—A com.
1182 J. Ives, Thame, Oxford—Velocipede

*17th April* 1869.

1183 P. Bogler and H. Kayser, Vienna—Lift for raising and lowering merchandise
1184 E. T. Hughes, Chancery Lane—Rifled firearms, ordnance, and ammunition.—A com.
1185 P. Bogler and H. Kayser, Vienna—Regulating the delivery of tickets at railway stations
1186 F. J. Knewstub, Jermyn Street—Printing
1187 H. W. Dee, Golden Square—Making bottles air and liquid tight
1188 T. Amies, Peterborough, Northampton—Heating water for greenhouses
1189 J. Willats, Kingsland, and J. Martin, Stratford—Mode of advertising
1190 T. Page, Adelphi—Rail, tramway, and road locomotives

*19th April* 1869.

1191 A. Smith, Mauchline, Ayr, N.B.—Ornamenting hats, caps, and bonnets
1192 R. Chapman, Shrewsbury—Fish-plates and the mode of fixing the same
1193 J. Horsley, Cheltenham, Gloucester—Blasting powder
1194 H. A. Bonneville, Piccadilly—Rims of hats.—A com.
1195 P. Bourchani, Paris—Hydraulic barometrical apparatus for raising beer and other liquids
1196 W. H. Smith, Strand—Lavatories, taps, valves, and fittings.—A com.
1197 H. Aitken, Falkirk, Stirling, N.B.—Treating iron ores or stones
1198 J. E. Ward, Bredbury, Chester—Hats
1199 A. V. Newton, Chancery Lane—Matches and match-boxes.—A com.
1200 H. Y. D. Scott, Ealing—Pottery ovens, kilns, and glass furnaces
1201 S. Shaw, Boston, U.S.—Feed-water apparatus for boilers.—A com.

*20th April* 1869.

1202 L. Goetz, Leith, N.B.—Cleansing wool and other fibrous substances.—A com.
1203 A. Brady, Maryland, Stratford, Essex—Producing iron direct from crude ore.—A com.
1204 F. W. Follows and J. Bate, Manchester—Sweeping carpets, lawns, and other surfaces
1205 N. Wilson, High Holborn—Sewing-machines
1206 F. Bartle, Pool, Cornwall—Dressing tin-ores

1207 R. J. Ellis and C. L. W. Fitz-Gerald, Laxey, Isle of Man—Drying animal and vegetable matters
1208 R. C. Rapier, Westminster—Railway signals—Water-cranes and lifting railway rails
1209 W. E. Gedge, Strand—Water-meter.—A com.
1210 K. S. Mackenzie, Bart., Gairloch, N.B.—Fences, hurdles, and similar structures
1211 H. Lee, Manchester—Looms
1212 G. Green, Aberystwith, Cardigan—Separating ores
1213 W. R. Lake, Chancery Lane—A toy.—A com.
1214 M. Andrew, Melbourne, Australia—Vessels for containing oil
1215 W. R. Lake, Southampton Buildings—Lamps.—A com.

*21st April* 1869.

1216 W. F. Reynolds, Commercial Road, and J. A. Mays, Finsbury—Velocipedes
1217 W. Holloway, Clapton—Manufacture of beverages from cocoa nibs
1218 J. Fletcher, sen., J. Fletcher, jun., and W. Fletcher, Salford—Lubricating the wheels of velocipedes
1219 P. R. Hodge, Adelphi—Manufacture of cloth or artificial leather
1220 E. O. Catrin, Paris—Application of a key to act as a cock at the upper part of bottles
1221 B. Picard, Ivry, France—Towing with sunk chains
1222 J. W. McCarter, Londonderry—Condensers for steam-engines
1223 T. C. Bull, Weobley, Hereford—Boots
1224 M. Henry, Fleet Street—Obtaining pyro-phosphate of lime.—A com.
1225 H. C. Mayer, Craven Street—Velocipedes
1226 M. Pletts, Newcastle-on-Tyne—Oil-feeders
1227 C. D. Abel, Chancery Lane—Materials for the preparation of mural paintings.—A com.
1228 C. M. Barker, Kennington Park Road—Steam generators
1229 W. Johnson, Swansea, Glamorganshire—Communicating between railway passengers and guard
1230 C. E. Brooman, Fleet Street—Dressing or finishing fabrics.—A com.
1231 W. Robinson, Tipton, Stafford—Manufacture of thin sheets or plates of steel
1232 J. H. A. Bleckmann, Solingen, Prussia—Firearms
1233 J. Francis, J. Donaldson, and G. Reavely, Galashiels—Locking apparatus for railway sidings to prevent carriages passing out

*22nd April* 1869.

1234 J. Holding, Manchester—Looms
1235 G. Dania, J. Stott, T. Stott, R. Stott, and S. Stott, Rochdale, Lancaster—Carding-engines
1236 H. T. Lewis and W. White, Handsworth—Hanging sash-frames
1237 J. Eccles, Radcliffe, Lancaster—"Lessing" warps
1238 G. White, Cheapside—Ship-weir or moveable dam for cleaning bed of rivers.—A com.
1239 W. Catchpool, Goswell Road—Treatment of hay and straw
1240 J. C. Ridley, Newcastle-upon-Tyne—Treating waste rails, ingots, and other scrap of Bessemer steel
1241 M. Hillary, Andover, Hants—Harrows or drags
1242 G. G. Tandy, Anerly Road, Penge, Surrey—Carburetting air or gas
1243 A. Borgnet, Swansea, Glamorgan, South Wales—Composition to be employed as paint
1244 A. Borgnet, Swansea, Glamorgan—Manufacture of paint
1245 W. R. Lake, Chancery Lane—Locks.—A com.
1246 W. R. Lake, Chancery Lane—Communicating between the passengers, guard, and driver of a railway train.—A com.

*23rd April* 1869.

1247 W. Palliser, Pall Mall, and T. English, Wandsworth, Surrey—Screw-bolts, unts, and washers for armour-plated structures
1248 N. Wilson, High Holborn—Velocipedes
1249 G. White, Cheapside—Motive-power.—A com.
1250 W. A. Lyttle, Hammersmith—Voltaic batteries
1251 G. T. Bousfield, Brixton, Surrey—Sheep-washing apparatus.—A com.
1252 S. Smith, Derby—Axle-box for railway carriages and waggons.—A com.
1253 W. B. Dick, Glasgow, N.B.—Extinguishing fires
1254 J. Whittaker, Oldham—Moulding wheels
1255 H. E. Newton, Chancery Lane—Preventing the bursting of boilers.—A com.
1256 H. E. Newton, Chancery Lane—Puddling iron.—A com.
1257 T. Wilson, Birmingham—Cartridges for breech-loading firearms
1258 E. Tatham, Nottingham—Levers and "nebs" or thread-carriers for warp-machines
1259 E. M. Reilly—Explosive bullets and apparatus for making them

*24th April* 1869.

1260 J. Major and W. Wright, Swallow Street, and G. H. Jones, Alpha Road—Whit lead and apparatus employed therein
1261 J. Thompson, Liverpool—Working machinery without fuel or labour
1262 H. Reed, Edgbaston, Warwick—Pneumatic apparatus
1263 A. Muir, Manchester—Stocks and dies for screwing bolts and other articles
1264 J. Weigel and B. Weigel, City Road—Shirt-studs and solitaires
1265 R. Foster, Liscard, Chester—Crushing and pulverising
1266 J. Head, Axminster, Devonshire—Harrows
1267 S. Brooke, Brighouse, York—Carding and preparing wool
1268 J. Crabtree, Sheffield, York—Cutting shives, bungs, corks, or pegs
1269 C. D. Abel, Chancery Lane—Velocipedes.—A com.
1270 P. Jensen, Finsbury—Sewing-machines.—A com.
1271 D. A. S. Mackintosh, Glasgow, N.B.—Cask spile
1272 A. Jack, Maybole, Ayr, N.B.—Reaping and mowing-machines
1273 A. Clark, Chancery Lane—Reaping and mowing-machines.—A com.
1274 J. Cudbird, Hingham, Norfolk—Motive-power machinery
1275 O. Engholm, Edinburgh, N.B.—Preserving articles of food
1276 O. Engholm, Edinburgh, N.B.—Retaining caught fish in life for market
1277 J. Scharr, Leith, N.B.—Liquid soap
1278 T. Forster and P. B. Cow, Streatham—India-rubber, gutta-percha or balata
1279 W. R. Lake, Chancery Lane—Axle-boxes for railway carriages.—A com.

*26th April* 1869.

1280 G. White, Cheapside—Carding tow.—A com.
1281 I. Farrell and W. Turner, Dublin—Velocipedes
1282 A. Watson, Newington Green Road—Sleeve-links, solitaires, and other fasteners
1283 J. Cunningham, Harpford, Devon—Apparatus for cutting sandwiches or bread
1284 H. Hall, Stafford—Obtaining motive-power and apparatus therefor
1285 J. K. Broadbent, S. Prestwich, and J. Prestwich, Farnworth, Lancaster—Steam and other furnaces
1286 J. Smith, Dublin—Self-acting signal apparatus
1287 A. V. Newton, Chancery Lane—Reversible parasol.—A com.
1288 W. E. Newton, Chancery Lane—Steam generators and condensers.—A com.
1289 R. Sterne, Cork—Anchors
1290 S. Oakman, Boston, Massachusetts, U.S.—Smelting and other furnaces
1291 G. Hawxhurst and J. Pollock, San Francisco, U.S.—Preventing the corrosion of steam boilers
1292 W. Prowett, Southwark—Knitting-machines

*27th April* 1869.

1293 W. R. Lake, Chancery Lane—Locks.—A com.
1294 J. P. Cooper, Bow—Nuts and bolts
1295 B. Dobson, Bolton, Lancaster—Carding engines.—A com.
1296 The Hon. R. Flower and M. Crowley, Queen's County—Organs
1297 J. Cane, Kew, Surrey—Cases or holders for fusees
1298 J. H. Sams, Aberdeen, N.B.—Seed-sowing machines and horse-hoes
1299 J. Anderson, New Buildings, Londonderry—Velocipedes
1300 R. Marshall, Burnley, Lancaster—Wheels for carriages
1301 H. W. Hart, Fitzroy Road, Regent's Park—Ovens for baking and cooking
1302 T. Aspden and E. H. Lambert, Leeds, York—Boots and shoes
1303 J. H. Simpson, Bolton Street, Piccadilly—Propulsion of trains by currents of air.

*28th April* 1869.

1304 O. Moseley, Bedford Street, Covent Garden—Smoking-pipes
1305 T. A. Haberkorn and B. Rudolph, Berlin—Sewing machines
1306 I. J. J. Lewis, Manchester—Ventilation of hats
1307 J. B. Kroll and A. Froment, Paris—Percolators for infusing tea and coffee
1308 G. Heyes, Radcliffe, and E. Barlow, Little Lever, Lancaster—Winding yarns or threads on bobbins
1309 N. Voice, Handcross, Sussex—Cask stands or tilts
1310 H. A. Bonneville, Piccadilly—Concentrating the caloric of heated water.—A com.
1311 J. Pim, Finsbury Circus—Ventilating apartments
1312 L. Isaac, Tottenham—Folding or collapsible tables, stands, and stools
1313 E. Cooper, Laurence Pountney Lane—Ventilating hats
1314 T. Bostock, Stone, Stafford—Applying elastic fabrics to boots and shoes
1315 R. B. Forbes, Boston, U.S.—Rigging square-rigged vessels
1316 J. Frölich, Barnes, Surrey—Generating gas
1317 A. Meredith, Newgate Street—Manufacture of iron and steel
1318 D. Greig, R. Burton, J. Gozney, and T. Atkinson, Leeds, York—Cultivating land when steam-power is employed
1319 W. E. Gedge, Strand—Pianofortes—A com.
1320 H. Bray and Henry Adams, Nottingham—Graining in oil colours.
1321 W. R. Lake, Chancery Lane—Generating and condensing steam, and furnaces.—A com.

*29th April* 1869.

1322 M. Wilkin, Paddington, and J. Clark, Finsbury—Radiating the axles of railway carriages
1323 R. Griffith, Highbury Grange—Velocipedes
1324 O. Rose, Bolton, Lancaster—Steam-engines
1325 J. G. F. Blow and G. W. Blow, Commercial Street—Driving-bands for machinery
1326 E. Crowe, Middlesbrough-on-Tees, York—Applying waste heat

*30th April* 1869.

1327 R. Elsdon, Brockham, Betchworth, Surrey—Kilns for the manufacture of lime and cement, or for the calcining of ores
1328 W. Spence, Quality Court, Chancery Lane—Manufacture of felt—A com.
1329 J. Broadfoot, Glasgow, N.B.—Lavatories
1330 J. Jamieson, Oldham, and T. Holt, Rochdale, Lancaster—Steam-engines
1331 F. Jackson and T. Corbett, Wigan, Lancaster—Lubricators for steam-engines
1332 F. Bujeaud, Rue du Gond Angoulême—Apparatus for making bottle envelopes
1333 A. Sleigh, Lancaster Road, Notting Hill—Obtaining motive-power
1334 R. F. Bigot, Paris—A level with mirror
1335 J. R. Jefferies, Ipswich, Suffolk—Horse-rakes
1336 H. J. Seels, Wainfleet Hall, Lincoln—Harrows
1337 R. Craig, Dalkeith, N.B.—Manufacture of paper
1338 R. Ward, Newcastle-upon-Tyne—Apparatus for baking, heating, or drying
1339 E. Tutte, Farcham, Hants—Hollow walls
1340 J. Smith, Rathgar, Dublin—Method of communication between passengers in railway trains and the persons in charge of such trains

*1st May* 1869.

1341 T. Greenwood, Leeds—Machinery for cutting joints for boxes, drawers, and other receptacles of wood
1342 J. Mackie, St. James' Street, Westminster—"Lock-fast" breech-loading firearms
1343 J. Wilson, Stockport, Chester—Bobbins employed in slubbing, roving, and other similar machines
1344 W. B. Robins, South Molton Street—Hand-pumps or syringes
1345 E. Waltham and T. Waltham, Stockwell—Engines to run on common roads
1346 J. P. Balm, Halifax, and R. Newton, Providence Mill, near Keighley, York—Worsted spinning frames
1347 J. B. Blake, Alton, Hants—Velocipedes
1348 G. Ritchie, Folkestone, Kent—Stop-hinges
1349 W. Broughton, South Street, Finsbury Market, and T. Steven, Glasgow, N.B.—Improvements in cooking ranges and other fireplaces, and in apparatus for carrying and turning cooking spits
1350 J. Conway, Stepney—Forge fires
1351 R. Saunders, Croydon, Surrey—Cable stoppers and controllers

*3rd May* 1869.

1352 C. T. Liernur, Frankfort-on-the-Maine—Daily inodorous removal and agricultural utilisation of human excrements
1353 P. Barry, Lombard Street—Delivering sheets of paper to the feeding apparatus of a printing machine
1354 J. Shackleton, Bradford, York—Utilising the exhaust steam from steam-engines, and apparatus for regulating the discharge or flow thereof
1355 S. H. Hodges, Bristol—Apparatus for the manufacture of heels for boots and shoes
1356 H. Williams, Liverpool—Velocipedes
1357 J. B. Nimmo, Edinburgh—Lever compensation door and gate spring or closer
1358 B. Hunt, Serle Street, Lincoln's Inn—Spinning hemp, flax, and other fibrous substances.—A com.
1359 D. P. Wright and C. Butler, Birmingham—Lamps for burning paraffin and other hydrocarbon oils
1360 F. W. Kaselowsky, Bielefeld, Prussia—Machinery for separating the woody part from the fibre of flax, hemp, jute, &c.
1361 P. Southern, Aspull, near Wigan—Furnaces

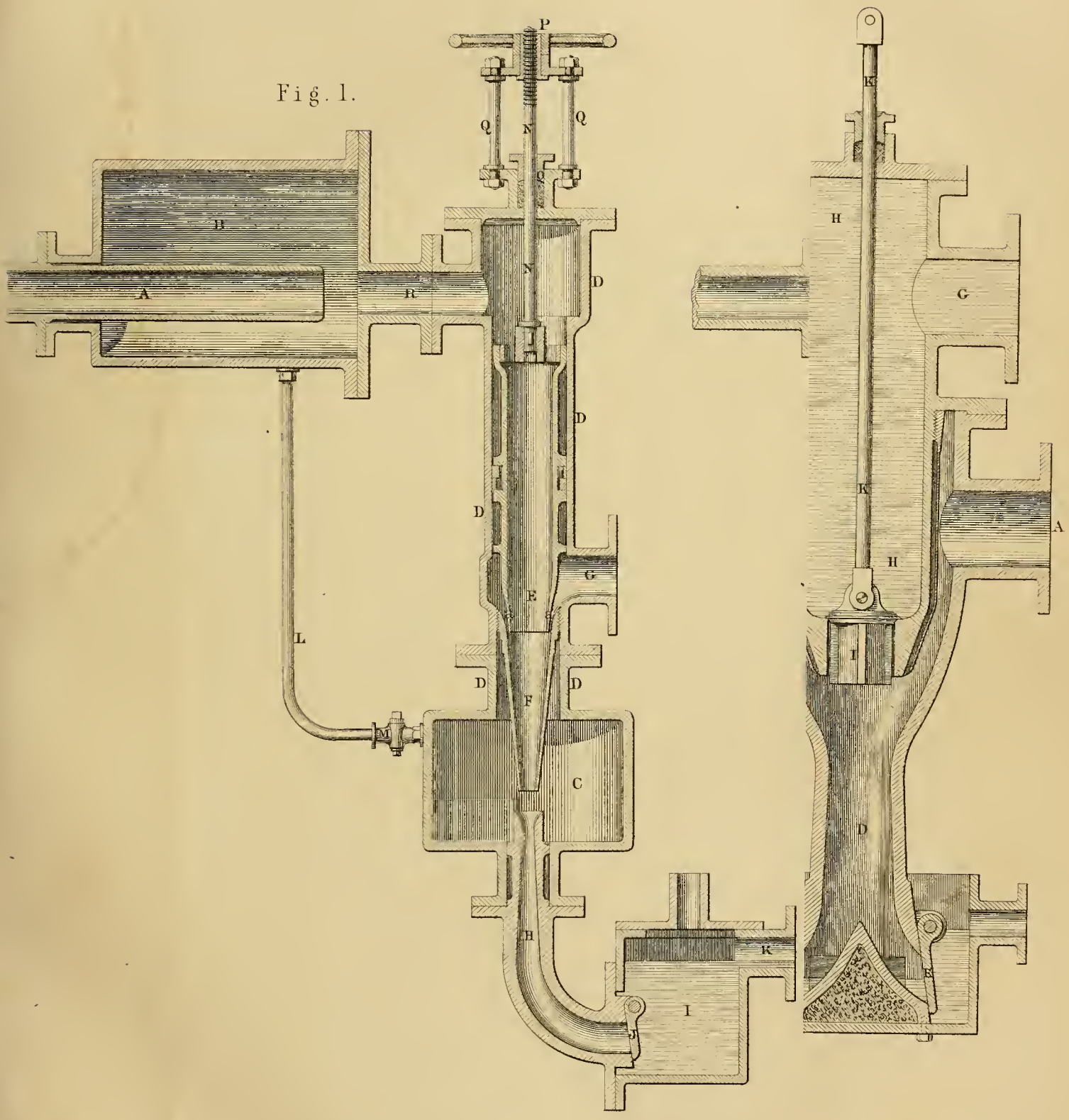
*4th May* 1869.

1362 W. Seed, Preston—Furnaces for steam boilers
1363 E. Thomas the elder and E. Thomas the younger, Meifod, Montgomery, and J. Morris, Welshpool—Agricultural implement
1364 C. Topham, Coleman street, Bunhill Row—Machines for mincing meat, vegetables, &c.
1365 R. Wappenstein, Manchester—Registering the numbers of passengers travelling in or on omnibuses and other conveyances, or entering public gardens and buildings
1366 T. Cockcroft, Bridge Lanes, Hebden Bridge, York—Hanging window sashes
1367 J. Bullough, Accrington, Lancaster—Warping or beaming machines
1368 R. Fennelly, Wellington Chambers, London Bridge—Cases for the conveyance of fresh meat
1369 T. Perkins, Hitchin—Reaping and mowing machines
1370 W. E. Gedge, Wellington Street, Strand—An anto-dynamic carbonic acid gas apparatus for raising liquids and for the preservation of beer.—A com.
1371 A. Fau and E. Fau, Castres, Departement of the Tarn, France—Washing, freeing from burs, and hairing skins
1372 J. Tall, Falstaff Yard, Southwark, and A. Williams, Great George Street—An improved apparatus for bending, curving, straightening, and flattening metallic sheets, plates, or bands, and also round, flat, square, angular, and other bars of iron or other metals
1373 A. V. Newton, Chancery Lane—Railway carriage wheels—A com.
1374 W. E. Newton, Chancery Lane—Engines to be used as motors or as pumps for raising or forcing liquid or aeriform bodies.—A com.
1375 A. C. F. Franklin, Abingdon Street, and E. Dubois, Primrose Street, Bishopsgate—Gas engines

BARCLAYS' "E"



Fig. 1.



# BARCLAY'S "EJECTOR" AND "BLOW-THROUGH" CONDENSERS OF 1867.



Fig. 1.

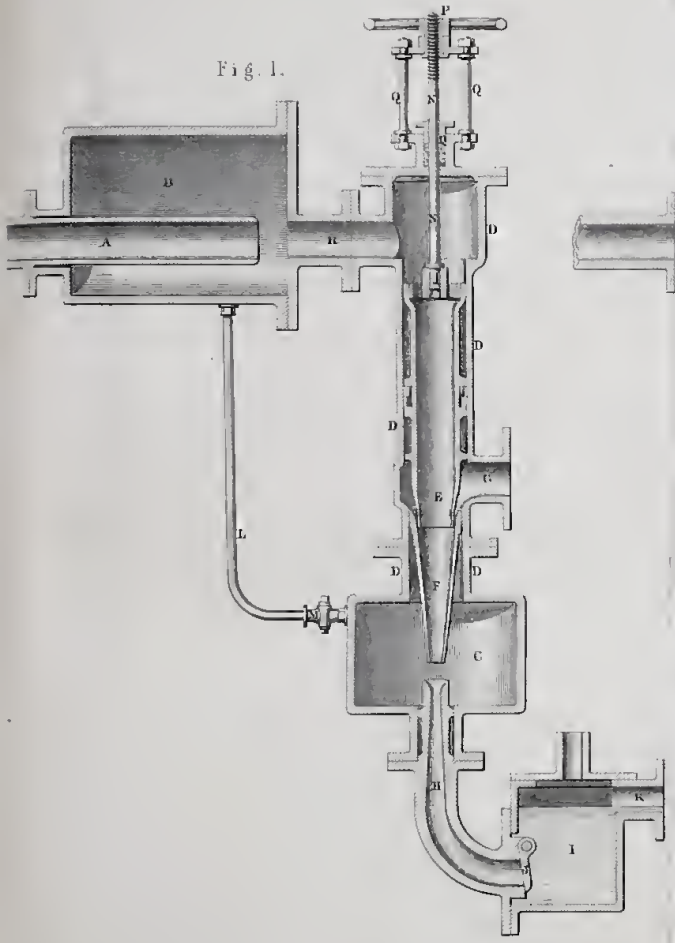



Fig. 2.

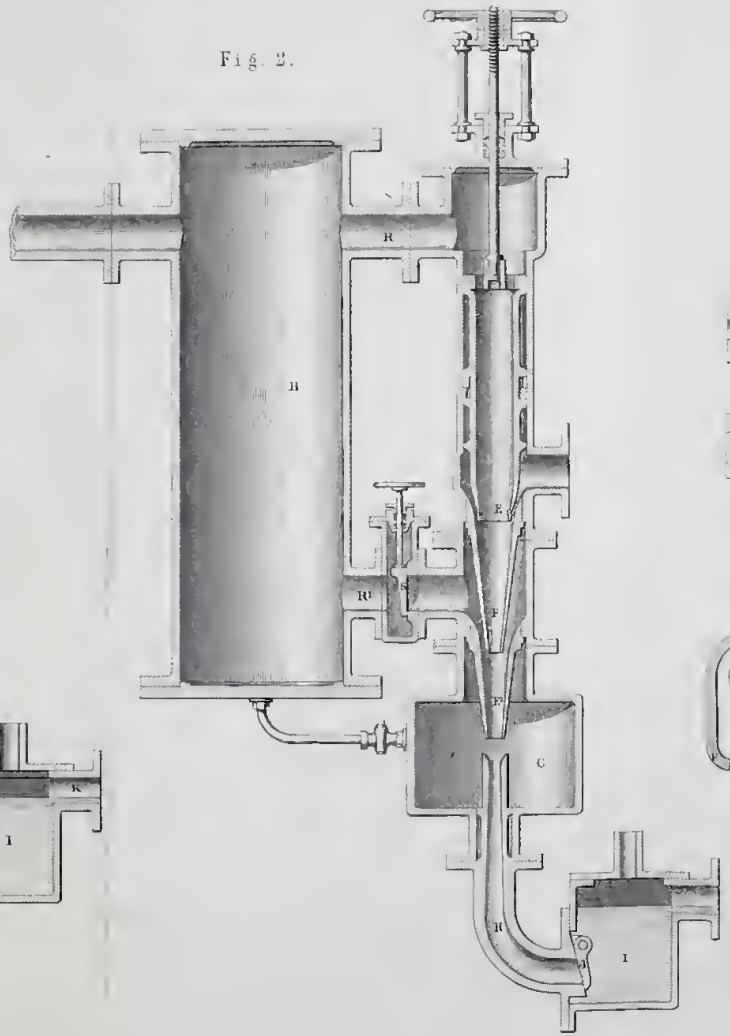



Fig. 3.

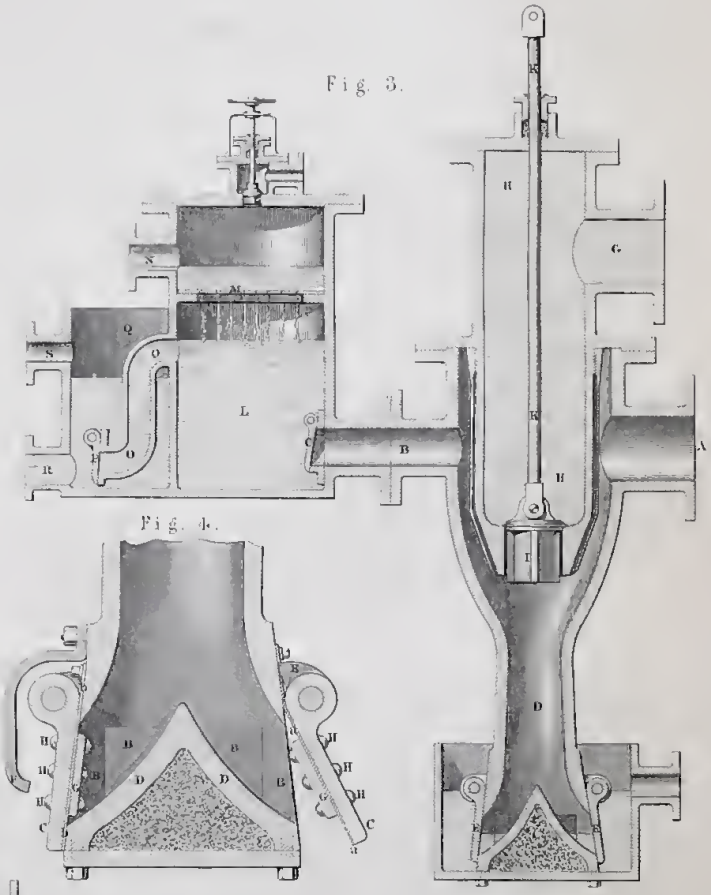



Fig. 4.




Patent Office.

## ON SOME POINTS OF PRACTICE IN IRON-FOUNDING.

### NO. XXXVII.

*Recent Modifications of Cupolas.*

SINCE the earlier papers of this series were written, several more or less novel modifications of cupolas have appeared in Great Britain or abroad. It appears worth while to record a brief notice of some of these, though rather as avoiding a *lacune* in our general subject, than for any very special merit that we suppose to attach to any one of them.

The fact is, as we have already stated, the common cylindrical or cylindro-conic cupola, when justly proportioned and well and continuously worked, is an instrument not very far from theoretic perfection; there is, therefore, no great room for improvement, in the sense of economising fuel, after what Mr. Ireland and others have effected. There remains, however, something to be done, especially with intermittently worked cupolas, in more rapidly bringing down the iron, and so saving time if not fuel; and there can be no doubt but that both time and fuel are economised by the use of hot blast, whenever or wherever that can be conveniently commanded, and at a sufficiently high temperature to be effective.

It is, of course, undeniable that heating the blast at all, must, *pro tanto*, save fuel; but unless it be brought to from 600° to 1200° Fahr., the economy is practically not worth counting in the cupola, whatever it may be in the smelting furnace.

Fig. 1.

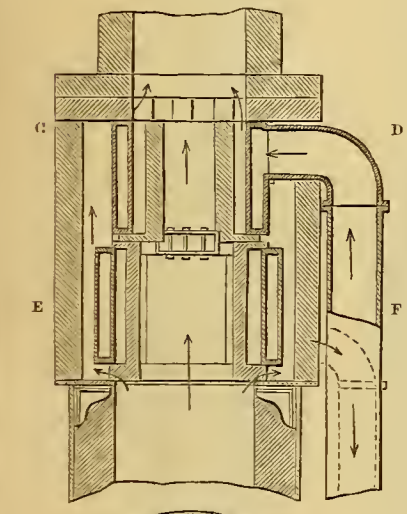



Fig. 2.

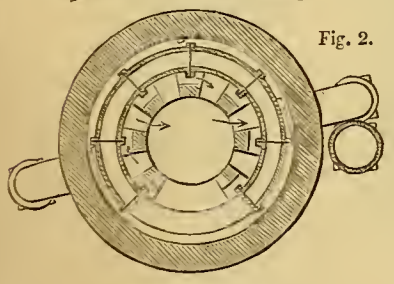
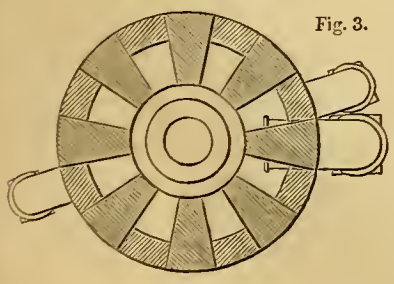


Fig. 3.



This want of effectively high temperature in the blast is the defect in a very considerable number of designs for cupolas, in which the waste heat of the flame &c. from the summit is proposed as the means for heating the blast.

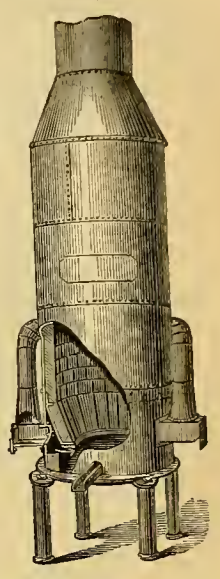
This has been attempted by piles of pipes crossing over the cupola mouth, by double-cased jacketing, by broad belts round the twyer holes, and in two or three other forms. The cupola patented by Thos. Summerson in 1865 (No. 1498) is one of the most favourable types of these.

This is shown in vertical section reaching some way down from the top of the cupola in fig. 1, and by the horizontal sections fig. 2 at E F, and fig. 3 at C D. It will be readily understood that whilst the flame &c. are made to play, in ascending to the stalk above, both outside and inside of two connected cast-iron double-cased cylindric drums, the cold blast is delivered into the interior of the upper or cooler drum, and delivered out heated (more or less) from the lower or hotter one, and passes thence downwards to the twyers.

A space is cut out at one side of the lower drum, to admit of feeding the cupola.

If this arrangement were combined, above the level of the upper drum, with a horizontal flue, before reaching the stalk, into which the broken pig-iron could be piled, and whence it could be pushed out and let drop into the body of the cupola, probably the waste heat might be economised, as far as it is practicable by any such arrangements. But there are several practical drawbacks to this or like schemes. They so encumber the mouth of the furnace that it is difficult to feed and fire the cupola, and difficult in working to see what is going on below; and these complicated forms in cast-iron, when exposed to the severe and constant alternations of temperature of cupolas, are scarcely ever permanently air-tight, and so leakage of blast at the joints may deduct far more than the very moderate heating of the blast thus possible may confer.

Fig. 4.



An attempt of this same sort, though by no means as happily conceived, exists in the Mackenzie cupola, an American patent, shown in partial section in fig. 4; a plan much vaunted and puffed in the American technical papers and journals, but of which we cannot think anything the better on such authority. Messrs. Smith and Sayer, of Liberty Street, New York, are, we believe, the principal makers of these cupolas.

A more curious, and possibly, in some respects, more promising design for making the cupola heat its own blast, consists in the Patent Cupola of Krigar and Eichhorn, of which accounts have been given in the engineering journals of November 1867, and in a lengthy communication made through Mr. C. Siemens to the Institution of Mechanical Engineers in April 1868.

This cupola is illustrated in figs. 5, 6, 7, and 8; fig. 5 being a front elevation; fig. 6 a vertical section at right angles to the

Fig. 5.

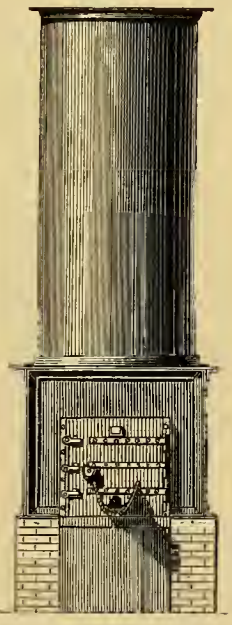
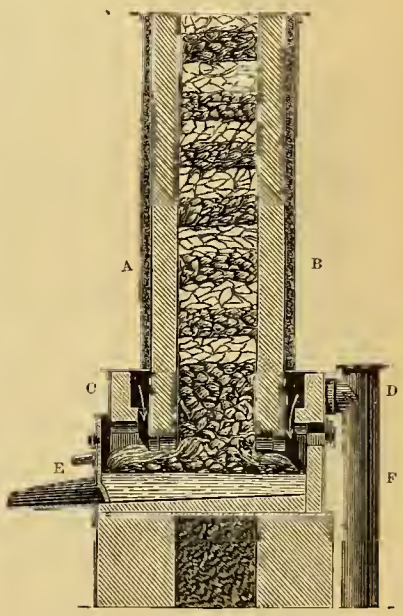


Fig. 6.




plane of the elevation fig. 5; fig. 7 a horizontal section at E F through the metal hearth or bottom chamber, whence it is tapped out; and fig. 8 two half-sections, the upper one through the shaft or body of the cupola at A B, and the lower one through the air-passages at C D. The general construction and working will be evident at a glance. The cupola is lighted, fed, and worked in the usual way. The column of coke and iron &c. supports itself upon the heap which spreads out upon the bottom of the hearth. As the metal melts, it spreads out upon the hearth and mixes up with this heap of heated cokes. Between the lower edge of the cupola

lining, which, it will be seen, is only supported upon a ring of cast-iron, there is assumed to be always space enough to let the blast introduced, either cold or hot, by the two blast pipes, to dip down, sweep over the heap of ignited coke and melted iron, and then rise up and escape by the column of matter in the cupola in the usual way. Now, the claim made for this cupola—and it is but just to the inventors to say, in some degree endorsed by Mr. Siemens—is that the plane of introduction of the blast is here brought down to the lowest possible level, so that there is the greatest height of more or less incandescent coke above it to convert the carbonic acid of the ascending blast back into carbonic oxide, and enable that to aid in the heating of the upper part of the descending column.

Fig. 7.

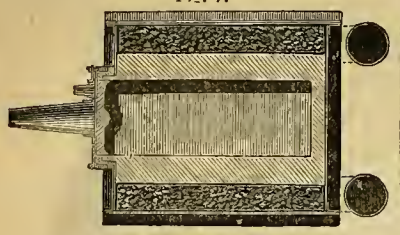
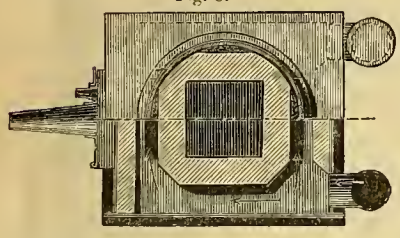


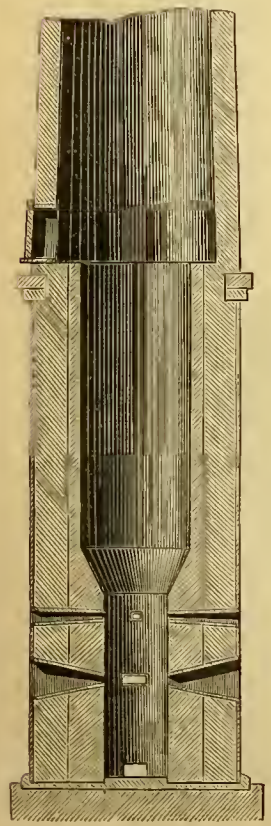
Fig. 8.



This is no doubt true. Further, it is alleged that less oxidation or burning out of carbon, or burning of cast-iron itself, takes place here than where, as with the ordinary twyer, the entering blast meets directly with the liquid iron, dropping down through the mass of coke, and seeking the bottom of the cupola.

Too much, to say the least, has been made of this assumed advantage. The real soft spot in the design appears to be this, that the heavy brick column of the cupola lining *cannot* be supported permanently and effectually. It rests upon a weak cast-iron ring, exposed to so high a temperature that we must assume it to be perfectly soft, usually, after the cupola has been a short time in blast.

Fig. 9.



This evil might be mitigated by partial supports at superior points, but cannot be wholly removed. Indeed, in a word, we should anticipate great practical inconvenience from the attempt to work hard such a furnace as this; nor do we deem its proposed advantages at all a counterbalance for these. Once more we affirm that, if the ordinary cupola be justly proportioned and skilfully fed and worked, the loss by oxidation, either of carbon or, still less, of iron, is not worth consideration.

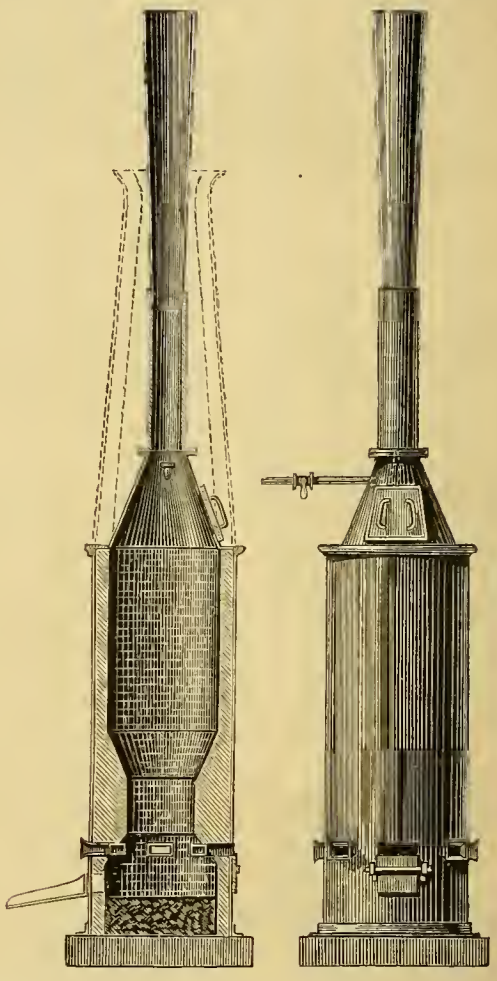
We know nothing more of these furnaces than what has been published in German or British journals. They have, it is stated, been worked in Germany for about eighteen months prior to April 1868, and for about six months in Lancashire and London, and with satisfactory results. The real proof of an invention being "satisfactory," is the extension of its use; and we do not find that those cupolas have got much further into play than they were two years ago.

However, for those who may wish to know more about them, or, rather, more of what can be said about them, there is the paper and discussion upon it in the proceedings of the Institution of Mechanical Engineers for April 1868.

We may now refer to a wholly different class of so-called "improved cupolas," namely, those which propose or profess wholly to abandon the use of an injected blast of air, and to obtain the requisite air-draught by other means.

The simplest, at least, of all these, is the cupola patented (we believe) by Mr. Heaton, the inventor of the steel-making process by nitrate of soda, and of which two large examples exist and have been worked (though not constantly) at the Langley Mills Works. This consists simply in constructing, upon the secure basis of an outer and jacketed lining or column, a very lofty stack or column; within this, at the lower part, as in the vertical section fig. 9, forming the lining with "boshes" of the cupola itself, and providing this with two layers of very large twyers of rectangular section. The furnace is filled and lighted in the usual way, and let to burn well up; and after it has got thoroughly heated, its interior all incandescent, and the earlier charges of coke, so, too, iron and coke together are begun to be charged in; and the draught and heat are maintained then simply by the ascensive power of the hot air above the cupola in the lofty stalk. It is neither more nor less, in fact, than an air-furnace in cupola form.

Fig. 11. Fig. 10.



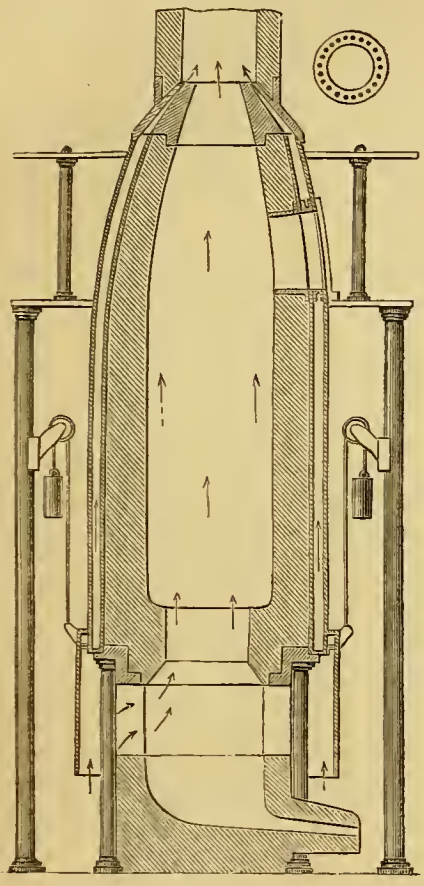
That it can melt iron is certain, for it is well known that no higher temperature can be produced by blast of given temperature, than by air-draught of the same; it is merely a question of relative time, when two furnaces—one draught, the other blast—shall arrive at the same maximum heat.

But the very essence of the cupola is the small losses, due to the rapid bringing up by blast to this maximum; and to us this class of furnace appears fundamentally a mistake. Probably its evils would

be found the least possible where, as proposed in Mr. Heaton's works, the demand for fluid iron would be regular and unceasing.

The cupola known in this country as Woodward's patent of 1865 (of Manchester), is shown in exterior elevation in fig. 10, and in vertical section in fig. 11. A jet of high-pressure steam, at 65° or 70°, the pressure is introduced at the top of the cone, just above the body of the cupola, and this produces the draught, just as does the blast pipe in the locomotive. The exterior air, or, if hot air, that from a surrounding belt, coming from the flue or heating-oven, enters, as in Mr. Heaton's, by the rectangular twyers around.

Fig. 12.



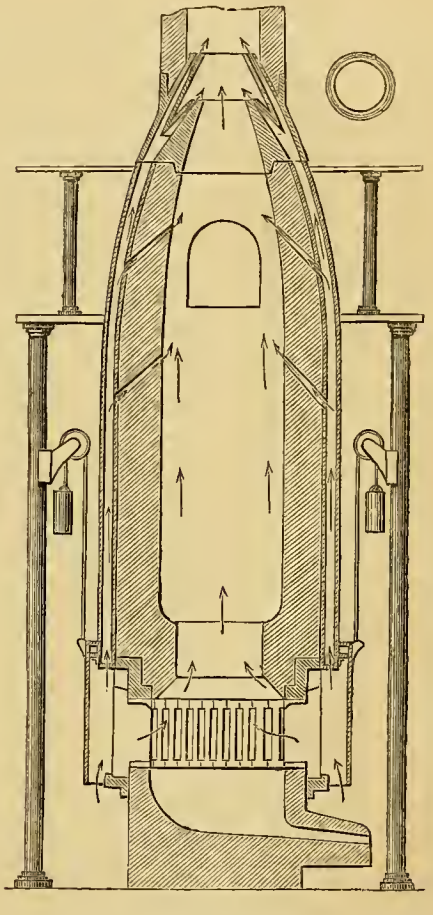
This is, in fact, a cupola with what may be called "suction draught." The claims of special advantages, modestly set forth for it by the patentees, are as follows :—Extreme simplicity, no engine-fan or gearing required, possessing no working or moving parts (we never knew of any cupola that had such), not liable to get out of order, very small consumption of coke, speed in melting the metal, wear and tear of furnace greatly reduced, improvement in the quality of the iron melted, perfect consumption of the fuel, &c. &c.

Of all these beatitudes we are sorry to confess we can only admit one, namely, that this cupola may enable a man who has a powerful high-pressure *boiler*, *but no engine*, to melt iron; but we apprehend a boiler of coffee-pot sort and size, and engine and fan to match, would do the work quite as well, and far cheaper. The blast in the locomotive costs nothing but the loss of power by a trifling back-pressure, because there is the steam, and it *must* be blown off. But it has been well ascertained, by those who have investigated the various means of moving bodies of air without great difference in density, how wasteful and costly is that by steam jet ; which for ventilating purposes is as old, if not older, than the days of Gurney and the old House of Commons. Nor is there anything new in its application to cupolas, at least elsewhere, if not in England. Mr. Grusen, of Magdeburg, whose ingenuity and real skill in all that relates to iron-founding are well known even amongst us, showed the writer, some years ago, sketches of a design he had made for a steam-jet cupola almost identical with this one. Except wastefulness in blast, and the absolute impossibility of ever urging the blast here beyond what the full-bore steam-jet at full pressure can pro duce, we find no fault with this plan of cupola ; but we see no ground to commend it on.

The last novel cupola to which we shall refer here, is that of Richard Canham, patented May 1865, No. 1448. This is also a *draught* furnace, and seems oddly entitled in the specification, "improvements in *blast* furnaces."

Two slightly different arrangements of it are shown in figs. 12 and 13.

Fig. 13.



The furnace body is divided into a sole or hearth near the bottom ; and into the body, which is well supported above that, a space between admits air to enter. This may be quite free, as in fig. 12 ; the heap of coke &c. in descending sufficiently blocking the aperture, and the liquid iron dropping through and into the hearth ; or, as in fig. 13, the space may be partially filled in by vertical firebricks of suitable shape, fitted into place radially all round, with air spaces between.

The jacket in either case is double, and part of the entering air passes up in the interspace, gets heated, and then enters amongst the coke higher up in the furnace. Finally, all the products of combustion are drawn away to the lofty stalk ; which—one to each cupola, or one common to several—is the only means of exciting the draught.

Figs. 12 and 13 also show the two forms of the topmost air-apertures of the jacket, at the entrance to the foot of the stalk.

The details of arrangement of this cupola are ingenious, and some of them, perhaps, admit of being adapted to a cupola, supplied with hot blast with real advantage. As it stands, however, it would prove quite on a par, we believe, with Mr. Heaton's, and be very much inferior to Woodward's steam-jet draught, and immeasurably so to a well-proportioned common cylindrical or Ireland's cupola with hot blast. The reader will thus perceive that in placing before him those several recent "improvements" (*!*) in cupolas—and we might have considerably added to the list by ex-

cərpts from Kerpoly *Bericht über die Fortschritte der Eisenhütten-Technik* and other foreign iron technical sources—we have rather given an *index vitandorum*, than presented him with what may worthily be copied or adopted.

Such being the case, we have not thought it worth while to enter very minutely into the particular merits or demerits of these several cupolas; but we have, we trust with clearness, stated the principles upon which we have judged them.—Ed.

## THE GREAT BRONZE FOUNDRIES OF FRANCE.

The casting in bronze, as the chief amougst several metals or alloys by which the artist can endurably entrust the conceptions of his imagination to a remote futurity, mounts as an art to the very earliest yet known origins of our race. China, India, Babylon, Egypt, Greece, Rome, the middle ages of our Europe, the Renaissance, and our own day contribute their monuments or testimonies of this. And yet, in some senses, the art has never spread, or become a diffused or universal one; at this moment there is really but one great bronze-casting nation in the world—France.

England has not been absolutely without attempt to establish bronze foundries of works of art; but while we have dozens of brass foundries existing chiefly as integral parts of our great engineering establishments, in which heavy and light bronze or brass castings, for parts of machinery &c., are made in great perfection, there really does not exist, we believe, in Great Britain a single bronze foundry devoted solely to the speciality of fine-art castings.

Nor are we likely soon to see such, for a great foundry of Bronzes, as objects of high art, demands the combination of two classes of industrial ability, only one of which we, as a nation, can command from amongst ourselves. We must obtain the respective manual skill of the moulder and founder, and, in addition, the hand and eye and genius of the modeller and the metal-chaser; and we may add, above all, that generally advanced and educated standard of taste amongst our people, more especially of the wealthier classes, to appreciate and reward their combined efforts.

This combination, of distinct but closely allied and mutually helping talents and powers, can never be broken up and yet success await the issue.

It is for this reason that, while we have had Bramahs (the younger), Robinsons, and Cottams &c. spasmodically attempting the art, and indeed making very fair castings—merely viewed as such—and have had (to say nothing of divers "men in brass jackets") colossal lions, moulded by a painter and cast by a marble sculptor, we have never yet produced a first-rate group in bronze; nor ever established artistic bronze-casting as a fine-art industry amongst us. The Bramahs and Cottams &c. were mere moulders, brass-founders; the Marochettis, whatever they may have been as sculptors, were trading speculators in casting statuary; an art of the refinements and details of which they personally knew nothing, and for the execution of which, in their pompously styled *ateliers*, they were dependent upon the hireling skill of workmen, who well knew the practical ignorance of their employers.

Prussia and Austria—especially the former—have been a good deal more successful; and almost wholly because they could command the poetry of art, and bring it into the foundry, which we cannot do.

And perhaps there is no single modern monument of fine-art bronze-casting in Europe or in the world, at present, of nobler conception and execution than the grand equestrian statue of Frederick the Great, with its surrounding figures and colossal base, on the Linden at Berlin.

Russia, too, has had her long-descended line of first cousins to bronze-founding in the men who cast the gigantic bells of the Kremlin, and her huge old bronze guns; and their descendants have produced some very noble statue castings, such as the Colossus of Peter the Great, and a good many very finely-cast statues of smaller size, such as the horses and horse-tamers presented to Ferdinand of Naples by the late Emperor of Russia, which are over the piers of entrance to the Palace garden at Naples.

But all these have been spasmodic efforts, sporadic results; in France alone has artistic bronze-casting taken firm root, not as an appanage of despotic extravagance, but as a noble and genuine branch of industry. It would almost seem as if this Roman art had descended to the French, as certainly the lineal successors in many respects of Rome and the people over the face of whose country Rome spread more widely and choicely the education and the solid monuments of her civilisation, than over any other area in Europe. This, however, would be but a fancy: the expansion and success of fine-art bronze manufacture in France, and, *par excellence*, in Paris, has really been due to the art-loving genius and impressionable imagination of her people, to their art-education, long continued and well understood by those who have conducted it in successive decades; and to the patience and *habileté* of her workmen, supported and empowered by the genuine knowledge and metallurgic science of those who lead them.

On the whole, brass and bronze-founding is much more of a speciality in France, in all its departments, than it has (hitherto at least) ever been in England. We do not make any reference now to Government foundries, such as the bronze gun-foundries of France or of England.

There are, however, in France, great establishments—such as those of M. Voruz, at Nantes—engaged wholly in bronze and brass-founding, and with special departments for artillery, for casting for mechanical purposes, and for statues and other objects of architecture and of art; all being, though of course with the usual fluctuations of trade, kept constantly at work. We are ignorant of a single like establishment in Great Britain. Paris is, however, the great head-quarters of fine-art brass and bronze casting, and practically supplies the world with its productions.

We view, as out of this trade altogether, the very numerous, and, in a trade-sense, important brass foundries of Birmingham and its neighbourhood, engaged upon small objects for house or domestic or other use, and which profess to have more or less of ornamentation, but certainly have but small pretensions to art, in any worthy sense. Nor do we refer to Japanese bronze and brass work, further han just to remark, that while objects of considerable, some of great, antiquity brought thence formerly by the Dutch, and more recently by ourselves and other European nations, prove that at some anterior epoch, artistic bronze manufacture had reached a very noble perfection, and great peculiarity and often beauty of treatment in design, more modern examples equally prove that the art has greatly deteriorated amongst that wonderful people, or that we now receive from them none of their best examples of art.

No English person who has been a day in Paris can have failed to be struck with the profusion of bronzes in the public ways, in the buildings public and private, and in the shop windows. Bronze-casting is, in fact, a great industry there. There are probably not less than three hundred houses engaged in the trade in one way or other; but of these there are not more than perhaps about fifty who are actual manufacturers, and of these again not more than about twenty who stand in the first rank, of ability and eminence, either as conducting some one or more special branches of the *bronzes des beaux-arts* trade, or the whole of them. But although thus the finished objects of the Parisian bronze-founder arrest the eye and glitter before us at every step upon the Boulevards or in the Palais-Royal, next to nothing is known generally, not even to the technical or metallurgically-skilled visitor to Paris, of the establishments whence these beautiful and costly objects issue, or of the apparatus and methods by which they are produced. They are, in fact, sealed, rigidly shut against all intruders, and for many good and sufficient reasons, which do not admit of being regarded as the mere offspring of narrowness, timidity, or jealousy. One only we need mention. The workmen are, in each of several classes, specialists, in a sense the most absolute, and French employers have found that unworthy and unscrupulous means to detach these men and bring them elsewhere, have been but too often practised by those to whom the grace of *entrée* may have been accorded.

We have heard, though we do not at all intend to suggest, that, in this way, fine-art bronze-casting in Belgium and in Germany has been very much advanced by the introduction of French artisans.

In Italy most of the workmen, in such establishments as that of Signor Clement Papi, which produced the largest bronze statue,

that of the David of Michael Angelo, in 1867 at Paris, are natives; but we believe this is not the case in Prussia, Austria, or Russia.

So far as we are aware, no literature exists which treats in a detailed or practical way of the methods and apparatus of the fine-art bronze foundry. We shall find none whatever where we might have expected it, viz. in the volumes of Reports of the French Imperial Commission of the Exhibition of 1867, or, indeed, in the reports of any preceding one. The reporter for 1867, on class 22 (Vol. III. of the collected reports) was M. Barbedienne, the man who perhaps, above all others, *could* have given us a complete and invaluable treatise upon the technicalities of this manufacture, in which he has so long and so conspicuously led the advance. We look for any such details in vain; not that we imagine M. Barbedienne felt the slightest desire or ground for reticence, but that the space assigned him in these volumes as a reporter was far too restricted to admit of his dealing with more than mere generalities; indeed, the whole 500 pages of Vol. III. might prove less than enough to enable, one at once so skilled in every detail æsthetic and technical and so enthusiastic, to pour forth the treasures of his knowledge upon this speciality, in which he so admittedly leads.

Where no literature exists, therefore, a sketch may be accepted as a not unwelcome instalment. Such we are enabled to give, the writer having been recently accorded by M. Barbedienne himself the unusual and special favour of the unreserved examinatiou of his noble foundry and manufactory at Paris.

There are, no doubt, half-a-dozen fine-art bronze foundries in or about Paris, the description of any one of which would prove interesting. That, however, of M. Barbedienne stands amongst these *facile princeps*, and indeed is not one, but, so to say, a congeries of special mauufactures. The works are situated in the Rue de Lancry, at not a very great distance from the well-known "show shop" of bronzes, as our homely phrase is, No. 30 Boulevard Poissonnière. It is, however, happily placed, though still upon the edge of that quarter of fashion, traffic, and pleasure, also upon the border of that wonderful north-east quarter of Paris, which, like our own north-east of London, is the seat of so many of its myriad industries, and which, as respects the French capital, is a *terra incognita* to ninety-nine out of the hundred Englishmen who visit that city, or even reside in its fashionable quarters.

Entering from the street, we pass through a range of offices, waiting-rooms, packing-rooms and stores, and find ourselves crossing a yard, and at once in the large bronze foundry.

The establishment comprises, in fact, the following departments if we may not almost call them distinct manufactories :—

1. The bronze foundry and its accessories.
2. The chasing-shop—*galerie des ciseleurs.*
3. The shops for the production of models, and for the completion of a large number of these in the permanent material bronze.
4. The marble work; a complete establishment for the working, both by machine tools and by the sculptor's hand, of all sorts of marbles, onyxes, and other fine and hard minerals.
5. The shops for mounting of Carcel lamps and other objects of artistic bronze work in combination with porcelain, glass, &c.
6. The enamelling shops, in which that peculiar form of "*émaux cloisonnés*" which, dating from Byzantine art originally, had been lost to practice for ages in Europe, though always employed in China and Japan, and were revived in France by M. Legost, in 1855, and greatly extended by M. Barbedienne.
7. The "*atelier,*" in which the delicate and beautiful machinery of M. Collas is worked for the automatic reduction or enlargement of solid forms.

This machinery is constantly employed in the production of new models for bronzes &c., whether figures or bas-reliefs &c., and of every size. It constitutes, as M. Barbedienne has himself affirmed, the right-hand of the bronzist, enabling him not only to reproduce the forms of ancient art with rigid exactitude, but to copy them equally so to any scale, and at an extremely small cost.

Were it not for this machine-tool, it would be impossible, at any reasonable prices, for M. Barbedienne to quote in his catalogue sometimes as many as eight different sizes for the same reproduced antique statue, and to have at command five or six sizes in bronze of nearly all the celebrated statues ancient or modern which enchant the world.

M. Collas' machinery gained him, and we believe very justly, the grand medal of honour at Paris in 1855. Its rudiments, however, are very ancient, and to be found in many an old book on turning; and in reality we believe there is little doubt but that all which M. Collas has effected was done, and thoroughly well done, by Cheverton in London as early, perhaps, as 1830; as those who have seen, or are happy enough to possess, specimens of his matchless reproductions to a reduced size, in ivory, of the antique bust of Clytie must be aware. Cheverton, however, worked his machine in secret in his chamber, and would not divulge its details, and we believe died without having ever fully and publicly claimed to have been its perfecter.

What degree of similarity there may be between both we cannot say, but all machines of this class in reality depend upon the use (more or less complicated, of course,) of a lever, the ratio of whose arms is variable at will, one end of which carries a dumb point which traverses, in closely and equally adjacent parallel lines, over the contour to be copied; while the other end, guided by that, carries the revolving or other cutting tool which removes the brute matter from the mass, to be formed into the reduced, or equal, or enlarged copy, and can remove no more.

8. Besides all these there are "mounting shops," where the bronze pieces are connected, either with precious marbles or stones, or by "*menuisiers-ébénistes*" with fine cabinet work.

Subsidiary to all these there is a grand gallery or store, for porcelains, Indian Japanese French English &c., to be employed for divers ornamental ends in combination, and a whole tribe of small shops for the preparation and repair of tools &c. &c. We need scarcely say amongst these are "drawing shops," artists' studios, in fact, where the imaginative brain labour that inaugurates much that follows, is in full play on the part of architectural and sculptural draughtsmen, and other artistic "*coopérateurs*" of the establishment.

Let us return to the foundry and its adjuncts, of which we can describe much to interest our readers, without any breach of the confidence reposed in us, as visitors to these famous works.

The foundry is a very large rectangular brick building, whose sides are about twice the breadth. It is lighted by ample skylights in the roof, and we at once notice the perfect cleanness of the walls and roof, and the nice clear pearl-white with which the brick of the former is coloured, so as to afford the best light without distress to the eye. There are no piles of rubbish about, neither spare-boxes, nor unused models; all is orderly, a picture of neatness.

The floor, with the exception of some gangways, is of loamy sand, everywhere in request, and ready in heaps beside each moulder.

The greatest proportion of the work being small, or very small, so the whole (nearly) of the moulding work is done on benches.

These occupy a large proportion of the whole area, and are arranged transversely to the length of the building in parallel ranges, with an axial gangway passing right through, and dividing them along the centre. Each bench is double, *i.e.* two benches and two sets of moulders face each other at work. Each bench varies in width from $3\frac{1}{2}$ to perhaps 5 feet; and the mid-line of separation between the opposite benches of the same double bench is occupied by a raised division, with a low table or shelf on top to hold tools &c. &c.

By far the greater proportion of the work is moulded

"in dry sand,"

the large statues being in true

"loam work,"

but

"green sand"

moulding for small, plain, or unimportant objects is also largely practised.

At one side of the "*salle*" is the place where the sand is prepared, mixed, and damped. The sand employed is of two qualities, one being of a deep brown colour, and very loamy; the other of a very light yellowish-white, with more yellow particles *parsemé.* Both are obtained at Fontenay des Roses, not far from Paris to the north-west. The two sorts are mixed, first, by interstratefying them in alternate layers in heaps, the relative thicknesses depending partly on the class of work the sand is being prepared for.

These zebra-striped heaps are then cut down with the shovel, and

the whole passed between a pair of very fine set horizontal cast-iron rollers. The sand is finally, after being damped to the right degree, sifted, and so handed over to the men. The "*châssis*" or moulding-boxes are all of cast-iron, very carefully fitted together, and with well-planed edges. We did not see a single wood box (so common even now in British brass foundries), nor any makeshift of any other sort about the establishment.

Wood patterns or models also are but little employed, except for objects to be finished in the lathe. The models are chiefly of bronze, carefully chiselled or chased up, and given a dull brownish-grey sort of "patina," which seems to enable them to part from the sand with very great cleanness. Plaster casts, fusible metal, wax, and even occasionally porcelain or glass come into play as models also. All the bench moulding-work is of a character demanding great care, dexterity, and patience. The latter quality, as well as steadiness of hand and perfection of vision, find their greatest demand with the moulders who are engaged in casting objects which are to form the basis for the *émaux opaques et cloisonnés*.

Our readers generally are, no doubt, familiar with the character of these, from seeing the like objects exhibited in Chinese and Japanese collections. The design, always of a stiff and conventionalised character, is outlined, as it were, and its distinct portions divided by very thin walls of bronze, mere lines almost, which rise square up from the general surface of contour of the object, and to a height equal to the depth of the intended coat of enamel, which is very thin, not more ever than a millimeter, seldom more than half as much. Thus, in fact the enamel when baked in, is held fixed in so many shallow bronze-surrounded cells, the dividing and adjoining edges of which are polished off bright, at the same time that the enamel is ground off to a uniform surface. This little digression may serve sufficiently to explain the nature of *émaux cloisonnés*; and into the details of the compositions of the enamels themselves, and how applied and completed, we do not here purpose entering.

It will thus be seen that the very utmost importance attaches to casting these little *cloisons*, or cells, perfect; any morsel of bronze improperly filling a portion, however slight, when cast, has to be cut out by hand, and at some risk of damaging the thin low wall of the *cloison* itself.

It is almost painful to watch the lynx-eyed patience with which the moulder of one of these objects—say, a huge vase of three feet in height, covered all over with thousands of these cells—finishes each, with minute almost microscopic hand tools, after he has "drawn" the bronze pattern. The value of this is represented mainly by the money consumed in payment for the design, the original wax and plaster model, and the casting and hand-finishing of this workable bronze pattern; such patterns are laid aside on cushions, and kept covered carefully.

We shall not devote space to describing the considerable system in operation for the organisation, registration, preservation, cleansing, and return into store, of the innumerable patterns. The law of copyright, which in France is far more protective and precise than it is with us, has greatly relieved such men as Barbedienne of one of their anxieties, viz. that of having their designs stolen, or their models bought for patterns by others; still, the *chefs d'œuvre* are guarded with care.

The facing sand of the moulds, whether dry or green, is prepared with a mixture of charcoal dust and of potato starch, or of wheaten flour of the very finest grinding. In the preparation of these each moulder takes his own way, and there appears to be as much whim and variation here, as amongst iron-moulders. Sand cores, amply hollowed for air, are employed for all hollow objects, not of large size or not cast in loam; for the latter, the cores are also of loam. In statue-casting it is deemed of high importance to the final perfection of form when cast, that the thickness of the casting should be perfectly uniform. This arises chiefly from the great contraction in cooling (from 1 to 2 per cent.) of bronze, and the prolonged state of plasticity through which it passes between the liquid and solid states. Hence, if there be thick parts as well as thin, the latter solidify so completely before the former that the thick parts get more or less distorted. The distortion may be utterly invisible to the undisciplined eye, but that of the artist-workman here readily detects and finds fault with a change of form in the muscles of a "*Discobalus*" or a "*gladiator*," or in the voluptuous rounding of the limbs of a "*Vénus accroupie*" or "*de Milo*," which the world at large cannot discern.

The contraction of cooling is found to augment in ratio, with the size of the object cast, being greatest in large statues. For all these reasons, the utmost care and some very refined, though simple, methods are employed to ensure that "the core" shall be in form precisely similar to the exterior of the statue or figure, and that it shall be placed and fixed in the mould with rigid concentricity. It is the opinion of M. Barbedienne, which he has expressed in his Jury Report (Class 22) of 1867, that wheaten flour is not so good a facing material as charcoal dust; but he deems that much remains to be learnt as to the best material for facing bronze sand-moulds, and hesitates not to say that no moulder now-a-days succeeds in attaining an equally *fine and uniform granulation* of surface as was habitually produced by some of the great bronze-founders of older days, such as Richard, the Ecks, Durand, and the brothers Keller who cast so much for Louis XIV.

It is also worthy of memory how fully M. Barbedienne insists upon the primary importance of perfection in the moulding and casting. Most persons would say that an object which was to pass into the hands of the "chaser," or *ciseleur*, might be cast as rough as we please, and yet all its faults be remedied in the metal-sculptor's hands. Skilled experience says no; it even goes so far as to say, if the work come out of the sand perfect, the less the "chaser" does to it afterwards the better; and, in fact, M. Barbedienne boldly attributes the matchless beauty of many antique, or even middle-age bronzes, to the fact that in these, the same mind eye and hand carried through the entire process, from the conception of the model to its completion, thence to the moulding and casting, and finally to the chiselling and dressing, and to complete finish.

This seems to have been true in some cases at least, if not in general. The exquisite bronze statuette of the young man, found about five years since at Pompeii, which has been called, though on no sufficient evidence, "the Listening Hunter," and which is undoubtedly one of the finest reproductions in the world, to reduced scale, of the youthful male form, as well as several of the great *relievo* castings of mediæval Italy, in gates and well ("*pozzi*") curbings, are cases in point.

But to return; at the end of the foundry, farthest from the entrance, are the furnaces, the stove for drying the moulds and cores, of which we need say nothing but that it is heated by the waste furnace-heat, and a large wrought-iron jib crane for pitting and unpitting boxes in which large objects are cast.

The bronze for all moderate-sized objects, say up to 250 kilos., is melted in clay crucibles, which are made in the neighbourhood of Paris, and hold about 30 kilos. each. These are not extremely refractory, but stand three or four meltings.

There are eight crucible furnaces, in form very much that of the ordinary brass furnace, but differing from usual practice, in England at least, in that they are not wind furnaces, but are fed with blast, from a small fan (about 20 in. diam.), driven by a strap from the engine of the "*marbrerie*;" the fuel is coke, and the advantages seem to be patent of this arrangement. The metal is "brought down," *i.e.* melted, very much faster, the "heats" can be repeated much more rapidly, and the consumption of coke is greatly less than with wind furnaces. Then again, when the crucibles are about to be "drawn," the blast is thrown off, and there is much less flare and heat to be endured by the man who lifts them out. The tops of these furnaces are of cast-iron, the covers of iron-bound square fire-tiles, and the tops are about 22 inches above the floor level.

The large air-furnace is fed with dry wood fuel, and will melt upwards of 1,000 kilos.

In older times statues were always cast in a loam-mould, put together piece by piece in the excavated pit, and, as fitted in place and jointed up, the pit was rammed up round them. This was but a makeshift mode, and had several serious evils: the mould never could be dried with perfect uniformity; and even when dry, it stood so long in the pit while being got ready, that it imbibed moisture anew, and hence so many "mis-casts" of old. Under the heavy head of liquid bronze, too, the ramming-in of the pit sometimes proved soft and deceptive, so that here or there the

walls of the mould partially bulged, and the casting was either lost or damaged.

All M. Barbedienne's statues or large objects are cast therefore in cast-iron flasks or boxes, so that the pit is what ironfounders call a "naked pit," *i.e.* no ramming-up is practised.

A "pool" or reservoir, of sand with charcoal facing, is employed for all large castings, into which the contents of the crucibles are "teemed," or into which the air-furnace is tapped. When the full quantity of metal is in the pool, an iron conical plug, which had been inserted into and stopped the main "gait" or "*coulée*," is drawn up, and the metal enters the mould.

It passes off (as overplus) by "rising heads," as in cast-iron moulding, and "the gas is fired" at these, by a lighted torch in the same way. From the low temperature of the liquid bronze, however, as compared with cast-iron, but a small volume of gas is evolved from either moulds or cores.

The head of surplus pressure employed is always very small, for fear of distortion; a practice exactly the reverse of that of bronze-gun founding, where the "*masselet*" or "rising head" is often nearly as long as the gun itself above its muzzle, which is uppermost in the mould. It may be very much doubted, or even on plausible grounds contested, whether any advantage is obtained by these very long "gun heads," and whether some positive evils in the increased segregation of the alloy be not thus introduced. Bronze-gun founding, however, is now, in these days of huge wrought-iron artillery, somewhat an art of the past, it may be said. We must remember, however, that Prussia is returning to bronze rifled field-guns, and that our new rifled Indian artillery is also to be of bronze.

The metals employed by M. Barbedienne for his bronze are, very pure "tile pitch" copper, and English or Straits tin, also of best quality. The copper is usually South American, again melted in France, purified by "liquation," and run into small pigs of about the size and form of ours known as "Best selected copper."

A proportion of bronze from "gaits and runners" is usually added, but the composition of this is *quam prox.* already known and constant, and its material is unadulterated, so no mischief can arise. No *old material*, whether copper, bronze, or brass is ever employed; and the *directeur du travail*, who so intelligently and politely showed us round the works, and explained their methods with the lucid brevity so characteristic of the higher *contre-maître* of France, expressed his opinion that it was impossible ever to cast a first-rate statue or relief, especially of large size, from old bronze guns, or other old material of variable composition. He instanced many proofs of this; and, undoubtedly, the porous bad castings of the reliefs of the Napoleon Column in the Place Vendôme, of the statue of Desaix, &c. at Paris, and of our own Trafalgar Square lions seem to sustain this view.

That bronze ornamentation is not more widely diffused in Europe generally, and that it is so prevalent in France, arises from two main causes. Fiscal or custom-house regulations of absurd severity in the case of all the European nations; and on the part of the United States, and as respects ourselves, want of diffused good taste or perception of beauty in form, either in the interior or exterior of our public or our private buildings or national monuments.

For 100 kilos. of bronze, on entering the frontiers of each of the following nations, the duties are thus:—

| | Bronze. | Bronze gilded. |
|---|---|---|
| Russia | 377 francs | 470 francs. |
| Austria | 250 „ | 250 „ |
| Spain | 155 „ | 155 „ |
| France | 20 „ | 100 „ |
| Italy | 17·17 „ | 100 „ |
| Switzerland | 16 „ | 100 „ |
| Prussia | 13·10 „ | 112·50 „ |
| In United States | 350 francs on 1,000 francs value. | |
| Belgium | 100 „ „ „ „ | |
| Holland | 50 „ „ „ „ | |

England and Portugal alone admit bronzes free.

The *bizarrerie* of these figures forms a curious commentary on the wisdom of finance ministers everywhere.

We must, however, reserve to a future article some further remarks upon these works for bronze, and upon ornamental zinc and iron castings, which follow humbly in its steps.—Ed.

## SEA-GOING TURRET-SHIPS.

The completion, at Chatham, of the *Monarch* affords a fitting opportunity for a few remarks on sea-going turret-ships. It is well known that the earlier turret-ships of our Navy—the *Royal Sovereign* and *Prince Albert*—are really coast-defence ships, since they have only a minimum of sail-power, and are so badly supplied with coal as to limit very narrowly their steaming capability; for coast and harbour defence they will, however, prove useful, should their services ever be required. Besides these, we have in our Navy the far-famed *Scorpion* and *Wivern*, built by Messrs. Laird during the American war, and purchased by the Government after they had been for some time in the custody of the authorities on suspicion of being intended for the Confederates. Perhaps no vessels have ever attained a reputation more disproportionate to their real powers of offence and defence than these two ships; for, although thinly-armoured and but weakly armed, they have been frequently described as most formidable vessels. We do not, however, propose to discuss the merits or demerits of those ships, but simply to add respecting them that, although intended to keep the sea, and therefore provided with a moderate amount of sail, they have proved very inferior sea-boats, the *Wivern* having particularly distinguished herself by excessive rolling. The advocates of the turret system have always argued that the bad performance of these ships was in a great measure the result of their moderate size (they being of less than 1,900 tons burden), and have urged the desirability of bringing the turret system into competition with the broadside system in ships which, in point of size, could compare with our armoured frigates; this trial will be rendered possible very shortly, when the *Captain* and *Monarch* are complete for sea. It would, of course, be folly to predict exactly what results will be obtained; one thing, however, seems certain, viz. that as sea-boats both of these vessels will prove far superior to any existing turret-ships; and there is every probability that the *Monarch*, if not the *Captain* also, will prove as efficient under sail as our broadside iron-clads.

Although classed together as sea-going turret-ships, there are some very great differences between the *Captain* and the *Monarch*. The former, we need hardly say, is supposed to be the fullest expression of Captain Coles' ideas respecting ships of the class; the latter was designed in the Controller's Department at the Admiralty, and must, therefore, be regarded as the representative ship of the type of which the naval officers then at the head of our Navy most approved, and which the professional officers did their best to perfect. Looked at by an unprofessional spectator, the *Monarch* presents no special features; she has the lofty sides and upper deck of a broadside ship, and is rigged in the usual manner. In fact, in all respects except the turrets, and some special arrangements of flying or hurricane deck for carrying boats, consequent upon the turret armament, the *Monarch* closely resembles the broadside ships which immediately preceded her. What would be the central battery on the main deck—if she were a broadside ship—is the space in which the turret-beds are built; and there are, of course, no port-holes in the side armour. On this central space or battery the armour rises to the height of the upper deck, about 14 feet above the water; before and abaft it there is an armour belt, extending throughout the length, and reaching from about 5 feet below the water-line up to a nearly equal distance above it. Instead of this, the *Captain* has her upper deck only 8 feet above water, and throughout the length the armour reaches from a few inches below this deck down to about 5 feet below water. She has a poop and forecastle above the upper deck, and a flying deck extends along the length between, this light deck being comparatively narrow, and being intended, unlike that of the *Monarch*, for working the sails. The *Captain* has tripod masts. Her turrets pass down through the upper deck, and the beds are built upon the deck below; the guns are, therefore, only about 9 or 10 feet above water, while in the *Monarch* they are 15 or 16 feet. This is, doubtless, an advantage of considerable importance in a ship like the *Monarch*, intended to fight in a sea-way, since she could use her turret-guns when the *Captain* would be powerless; but this advantage has been purchased at a considerable cost. First of all, the *Monarch* is 800 tons burden more than the *Captain*, although she only carries about the same weight of

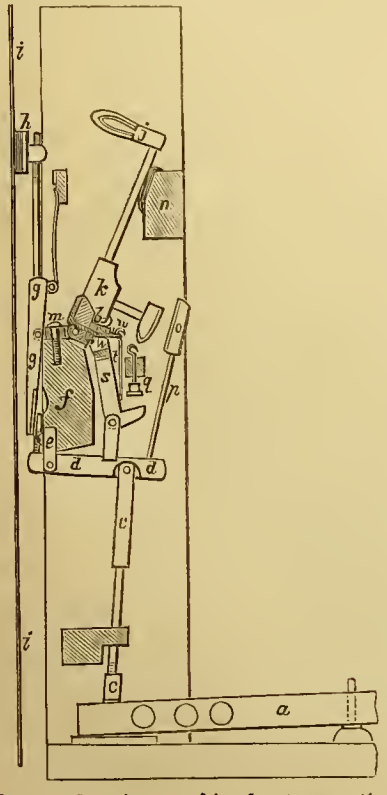
turrets and guns as the *Captain*, and has armour of the same thickness; the different disposition of the armour in the *Monarch* requiring a much greater weight of armour than the *Captain's* system would require, and the lofty sides, of course, adding to the weight of hull. Then the *Monarch*, being a larger ship, has a greater weight of equipment, heavier and more powerful engines, and a greater weight of coal than the *Captain*, all of which, of course, must be regarded as the result of the difference of types. The side armour of the ships is nearly all 7-inch; the *Captain* has a little 8-inch in wake of the turrets. On the turrets the armour is 8-inch and 10-inch, the greater thickness being used near the ports. The turrets, of which there are two in each ship, will each carry 2 25-ton guns, throwing 600-lb. shot. Besides these the *Monarch* has 3 6½-ton guns, two of which are in an armoured bow-battery, and the third in an armoured stern-battery; the *Captain* has 2 6½-ton guns carried unprotected on the poop and forecastle.

In conclusion, we would remark that the turret system is at a great disadvantage when applied in a full-rigged sea-going ship like the *Monarch* or the *Captain*. By means of poops, forecastles, stays, shrouds, tripods, or other obstructions, it becomes impossible to fire the turret guns in very many directions, and hence the chief merit of the turret system—an all-round or nearly all-round fire—is forfeited. Direct fire either ahead or astern, both of which are most important, is entirely out of the power of the turret-guns of both ships; the *Monarch*, by means of the bow and stern batteries, making up for this failure to some extent, while the *Captain* is the most unsatisfactory of our recent ships, in so far as what are termed "arcs of impunity" are concerned. In fact, no greater contrast between ships can exist than that between the *Captain*, which has no power of firing within, say, 15 degrees of the line of keel either ahead or astern, from her turrets, and the broadside ships of the *Invincible* class which, from armoured batteries amidships, can command an all-round fire. In this most important respect the broadside ships have completely outstripped the turret ships.

## BRINSMEAD'S IMPROVEMENTS IN PIANOFORTES.

Among the recent and most important improvements in the construction of pianofortes, are those patented a short time since by Mr. John Brinsmead, of Wigmore Street, and which, notwithstanding their having been noticed in other journals, we consider of sufficient importance to warrant a permanent record in our pages.

Fig. 1.

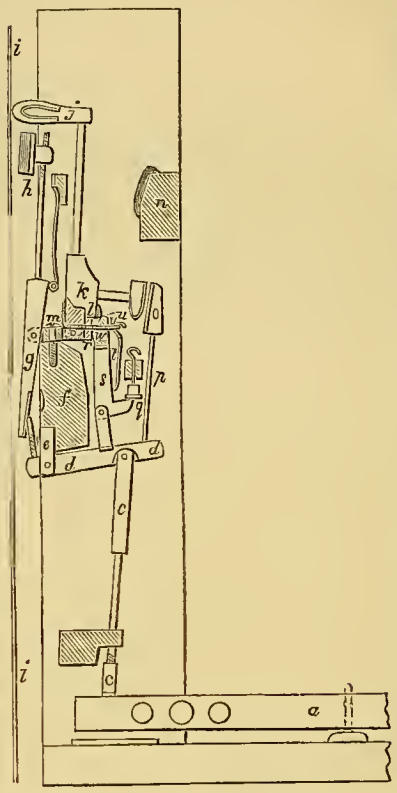



The improvements relate to an improved action for pianofortes, and the object is mainly to obtain a repeat combined with a perfect check, and may be briefly stated to consist in a particular position and action of a spring and loop, and in forming the sticker or hopper with an incline at the top which presses on the front of the notch after escapement has taken place. A spring is connected to the lower part of the sticker, is carried up, and formed at the top into a hook; from the hook a loop is carried through a slot in the sticker, or at the sides of the sticker, and the loop is connected to the butt under the notch. The loop and spring combined act as a tie-leather, never allowing any great space between the sticker and the notch, the ordinary tie-leather or tape being dispensed with. The position of the loop and spring allows the hammer to drop freely, answering at the same time the purpose of keeping the sticker on the cushion at rest, the spring being at its least tension.

This arrangement may be modified by fixing the spring to the butt and the loop to the sticker, which latter then escapes backwards by the motion of the lever, and depends for its cushion on a loop fixed to the beam passing through a hole in the sticker and fastened to an eye.

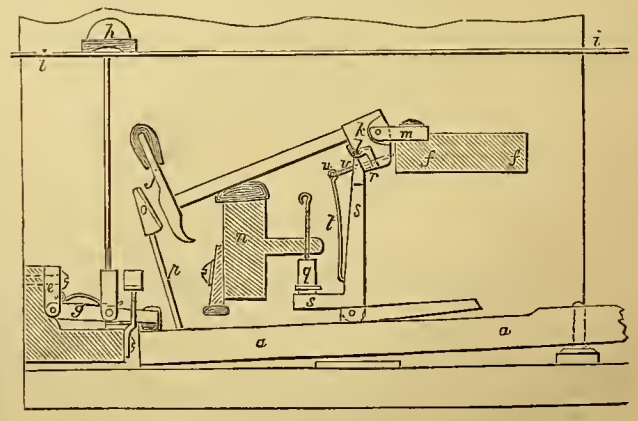
The improvements will be clearly understood on reference to the annexed engraving. Fig. 1 represents the improved action applied to an upright pianoforte, the parts being in the position they occupy when at rest; fig. 2 is a similar view with the parts in the position they occupy when the hammer strikes the wire; fig. 3 represents the improvements applied to a grand pianoforte.

Fig. 2.




*a* is the key; *c*, the key sticker or prolonge; *d*, the lever; *e*, the bracket; *f*, the beam; *g*, the damper lever; *h*, the damper; *i*, the wire; *j*, the hammer; *k*, the butt; *l*, the notch of the butt; *m*, the rail; *n*, the hammer rest; *o*, the check; *p*, the check wire; *q*, the escapement; and *r*, the cushion for the hopper: all these parts are of the ordinary construction. *s* is the hopper, which is inclined at the top, the incline pressing on the front of the notch *l* after escapement has taken place, as seen in fig. 3; *t* is a spring connected to the lower part of the hopper *s*, and bent at the upper end into a hook *u*; *v* is a loop or cord carried through a slot *w* in the hopper and connected to the butt *k* under the notch *l*. The inventor prefers to carry it through the butt and fix it at the back thereof. The loop *v* and spring *t* combined act as a tie-leather, never allowing any great space between the hopper *s* and the notch *l*, the ordinary tie-leather or tape being dispensed with. The position of the loop *v* and spring *t* allows the hammer *j* to drop freely,

Fig. 3.



answering at the same time the purpose of keeping the hopper *s* on the cushion *r* at rest, the spring *t* being at its least tension.

The result of these improvements is (1), that directly the blow on the string is struck, the hammer escapes from it, and is caught by the check, thus producing a better and more "singing" quality of tone, as the hammer cannot touch the string a second time to stop the string's vibration. (2.) When this has been attempted before, as the check held the hammer, no second blow could be struck unless the key was allowed to rise to a level with the others, so that the repetition was entirely sacrificed. In Mr. Brinsmead's action the note can be repeated with certainty and force, even when the key is pressed down to within one-eighth of an inch of its utmost limit. (3.) The spring is at one end fastened into the sticker or hopper near the bottom, and the hook at the top of the spring is held by a silk loop which is fastened *under* the hammer butt and passes through the slot in the sticker, thus drawing the sticker and hammer into their proper positions ; answering every purpose that several springs have hitherto been employed to effect, and rendering such complication of pieces and centres totally unnecessary. (4.) The top of the sticker is bevelled, so that the sticker regains its position at once, as well as allowing it to escape freely. (5.) It also obviates having a space between the hammer butt and sticker, which produces that disagreeable flimsiness of touch, and in a short time (from the sticker continually *striking* up against the leather on the hammer butt) that rattling which players complain of so much : this action has no space between sticker and hammer, for the bevelled top allows the sticker to escape and return freely even when close against the hammer, so that it only *presses* instead of striking ; and it then *slides* off along the bevelled top instead of causing the friction of sharp corners of an ordinary hopper against the leather on the butt; this absence of friction causes the action to wear far longer than the ordinary action used. (6.) The hammer escapes from the string the moment it strikes it ; even a momentary stoppage of the hammer against the string would cause a great diminution of tone, as it would stop many vibrations, for the string when set in motion vibrates some hundreds of times in a minute : the blow on the string is so direct from the key that no power is lost, and a much sharper blow and consequently richer and more powerful tone is produced, the instantaneous, almost electrical escapement allowing the vibrations to continue without hindrance. (7.) It is impossible even in damp rooms for this action to "block" (stop against the string altogether, through the swelling of leather, vellum and cloth hinges and coverings in ordinary actions), as the arm from the sticker, when pressing against the escapement button, *forces* the hammer instantly to leave the string after striking it, as previously mentioned. (8.) The absence of complication in springs and pieces of mechanism allows the touch to remain beautifully light, and gives it a firm, elastic pressure against the finger, and is so equal that the utmost delicacy or greatest power in execution can be produced with ease and certainty ; allowing a player to execute difficult passages without one-half the practice necessary for producing the same effect on another piano. (9.) In case of accident the action is so arranged that, without moving or interfering with any other piece, any damaged part can be removed for repair simply by turning two screws. (10.) The instant the finger is removed from the key all sound ceases, the damper acting so quickly and effectually. (11.) This action cannot miss a blow, even in *the most rapid and delicate passages in playing*. Fulness and power of tone, rapidity of "speech," and melodious sustaining quality of tone, and a light, delicate, firm touch are thus gained by these extremely simple means.

## ON INSTRUMENTS FOR INJECTING AND EJECTING FLUIDS AND LIQUIDS.

(*Continued from page* 56.)

(*Illustrated by Plate* VI.)

On account of the space taken up last month by that portion of our article preceding the reference to Mr. Barclay's ejector-condenser, we were compelled to make our allusions to it as brief as possible ; in fact, leaving the matter so far incomplete, that the starting of the apparatus into operation was not described ; but we hope on the present occasion to make that operation clear. A careful examination of Mr. Barclay's specification of 1864 will show that, not only as a condenser was this instrument designed, but also for use in propelling liquids or fluids of different temperatures, the variations in which—that is, between the liquids or fluids propelled—may lie between almost any limits. Now, it is interesting to notice here that in whatsoever way this twin-nozzled instrument is employed, whether as a steam-engine condenser or otherwise, the instrument really propels fluids of different temperatures, particularly so at the time of starting it into action, which is thus described in the specification :—"To secure the very effectual working of the instrument prior to the admission of the heated fluid (which, in the case of using the instrument as a condenser, is the exhaust steam*), a colder fluid—or one possessed of a temperature sufficiently low to ensure the action being effective—is first admitted. . . . And this coming in contact with the steam-jet (*i.e.* starting-jet) causes the latter to be speedily condensed. . . . So soon as the action of the instrument is ensured, by the admission of the cold water and steam, then the heated liquid† (exhaust steam) is admitted, and is, as it were, pulled forward through the nozzle by the rushing action of the colder fluid." In fact, the instrument is started by turning on a little live steam direct from the boiler, which puts the water-jet into operation, that is, insures the action of the instrument, after which the exhaust steam is admitted and the live steam shut off.

Besides the experiments to which we referred last month for the purpose of ascertaining the degree of vacuum which could be formed by the double or twin-nozzled instrument, illustrated on Plate V., other experiments were also conducted with that form of instrument, the lower part of which is shown by woodcut fig. 11, page 56, with the view of ascertaining the depth from which it was capable of lifting water.

It is well to repeat here that at this period Giffard's instrument could not be started into operation to lift water from a greater depth than 5 feet, and Morton's instrument 14 feet ; but in the experiments made by Mr. Barclay, a fluid column of from 20 to 28 feet was maintained ; and it was further found that, when supplied with steam of 25-lbs. pressure per square inch, this instrument would, after drawing water up from a depth of 14 feet, elevate it to 60 feet above the discharging throat.

Early in 1865 Mr. Gresham, of the Atlas Works, Manchester, sought to increase the lifting power of Giffard's injector, in order that, on starting, it might lift a liquid from a depth below it approaching that from which an ordinary suction or lift-pump will elevate it.

Previous to this, in order to use the injector for elevating from greater depths than about 5 feet, it was the practice to charge the feed or suction-pipe with water, and keep it supplied from a convenient level until the instrument was fairly in operation, at which time the temporary or auxiliary supply was cut off ; the injector then, of course, continuing to draw the liquid from the low-level supply. This mode of charging the injector was generally effected by placing a small tank or cistern a few feet above the level of the injector ; the tank being filled, when required, by the injector.‡

An important feature of Gresham's improvements consisted of a method of charging the injector by drawing the feed-water or liquid up the suction-pipe sufficiently high to enable the injector to start into operation ; this being effected on forming a partial vacuum by means of a steam-jet, the chamber in which such vacuum is formed being brought into communication with the feed or suction-pipe of the instrument. This was carried out by means of the apparatus shown at figs. 1, 2, 3, and 4.

The injector shown at fig. 1 is of the construction devised by Robinson and Gresham towards the end of 1864, in which the con-

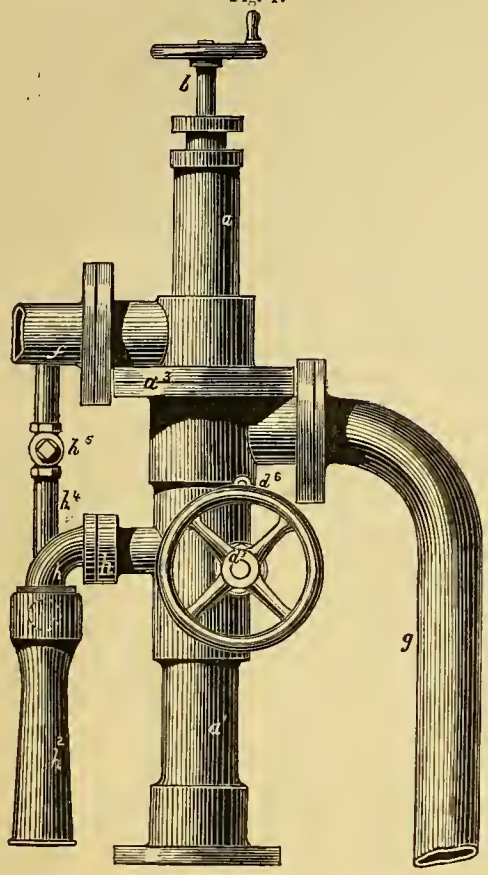
* This and the following parenthetical sentences are our own, and here introduced for the sake of explicitness.

† The specification has *liquid* in the particular passage quoted; but our readers must understand that it may either be a *liquid* or a *fluid*, according to the manner in which the instrument is worked, either with "two jets of the injected or ejected fluid, with an annular jet of steam situated concentrically between them, or, instead of this, two jets of steam with a jet of water intervening," as stated at page 7 of the specification.

‡ For further information as to this arrangement, see Gresham's Specification, No. 410, 1865.

verging throat is adjusted by the hand-wheel *d*, which actuates a pinion on that part of its spindle situate at the interior of the instrument, gearing into a toothed rack formed on the exterior part of the converging throat; *g* is the suction-pipe, *f* the steam-pipe, and *h* the overflow-pipe of the injector. A branch pipe $h^1$ is secured to the overflow-pipe of the form shown in the enlarged detached

Fig. 1.




view fig. 2; and upon this another pipe $h^2$, of trumpet form, is screwed as shown, so as to surround the nozzle of the branch pipe $h^1$ and form an annular chamber $h^3$, as shown by fig. 3, a section at A B fig. 4. This annular space or chamber $h^3$ is connected by means of a pipe $h^4$, having a tap $h^5$ upon it, with the steam-pipe, as shown in fig. 1. When the injector has to be started into operation with this apparatus, the tap $h^5$ is turned on, and the steam then escapes through the annular space between the nozzle $h^1$ and the external pipe $h^2$ and creates a partial vacuum, which acts to draw the water or liquid up the suction-pipe *g* through the water space between the cones or nozzles of the injector (which is open) and through the pipe $h^1$, and, when it is seen escaping, the steam is turned on to start the injector in the usual manner, and when it has got to work the tap $h^5$ is turned off. The exhausting or vacuum apparatus may be modified in various ways; for instance, the steam or other jet may be brought into the centre, and the chamber surrounding it may be made to communicate with the overflow orifice.

Figs. 2 and 3.

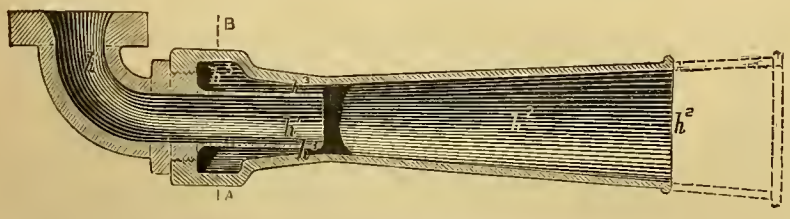
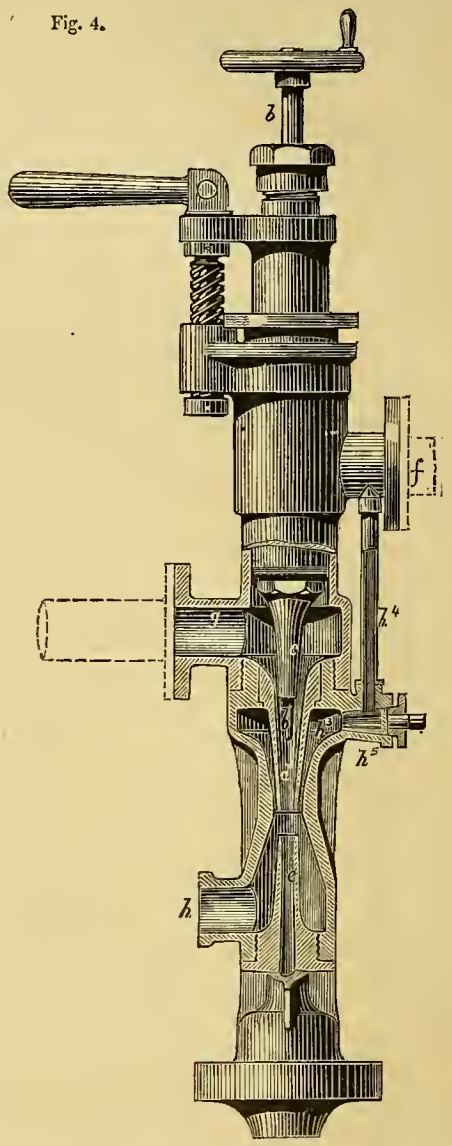



Fig. 4 is an outside view, partly a longitudinal section, of an ordinary injector, having a fixed discharging cone or nozzle *d*, but modified to embody the improved mode of lifting the water, so as to charge and bring the injector into operation. *f* is the pipe for supplying the injector with steam; *g* the suction-pipe; *c* the partition cone or nozzle; *b* the central cone spindle; *e* the receiving cone or nozzle; and *h* the overflow orifice. The discharging cone or nozzle is surrounded by an annular chamber $h^3$ as shown, and this chamber is made to communicate with the steam-pipe *f* through

Fig. 4.

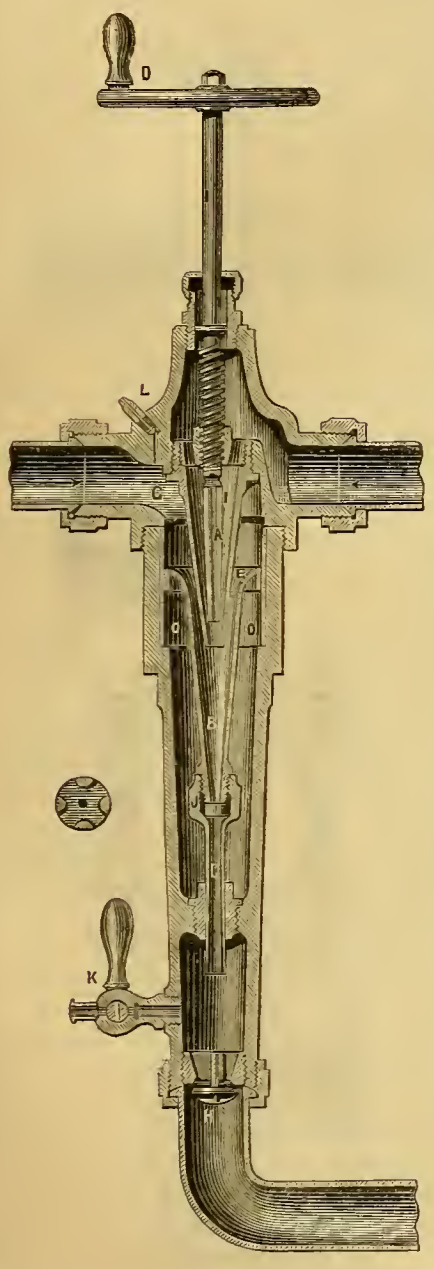



a tap $h^5$ formed upon the side of the injector and a branch pipe $h^4$ as shown. This injector is started into operation in the same manner as that shown at fig. 1.

In the early part of 1865, William Sellers, of Philadelphia, U.S.A., the well-known machine tool-maker, improved the injector so far as to make the instrument self-regulating in respect of the supply of water and steam. This he effected in using the overflow to control the admission of both, so that the pressure inside the chamber caused by an overflowing jet, diminishes the water supply, or increases the supply of steam, or it may effect both; whilst the water, which has escaped at the overflow to produce this effect, being retained in contact with the jet is drawn in again whenever the supply of water is too small, or the supply of steam is too great; and thus produces a partial vacuum in the overflow-chamber, reverses the previous operation, and re-

adjusts the instrument to the new conditions without any waste at the point of overflow. The instrument shown at fig. 5 represents one modification of the injector, as arranged by Sellers. In this case, the steam cone A is fixed; and as the exact quantity of water which the steam is capable of taking up is always admitted to the instrument by the aid of the self-adjusting property, it is evident that the instrument, once having the steam adjusted for the maximum delivery, continues to deliver the maximum quantity of water which the pressure of the steam at any moment renders possible. The self-adjusting injector is constructed as follows; in fact, we here quote Mr. Robinson's own description, from the "Transactions of the Institution of Mechanical Engineers":—"A is the steam cone; B the combining cone; C the receiving cone; and the admission of steam through the steam cone A is regulated, as hitherto, by the handle D of the spindle I; the combining cone B at its base is so made as to form a piston E, which separates the water-chamber G from the overflow-chamber O. The interval J forms the entrance to the receiving cone, and also to the overflow-chamber O, as shown in transverse section fig. 6. The boiler-valve H prevents the water returning from the boiler, and K is a waste-cock, which, when open, allows the water and steam to issue into the atmosphere."

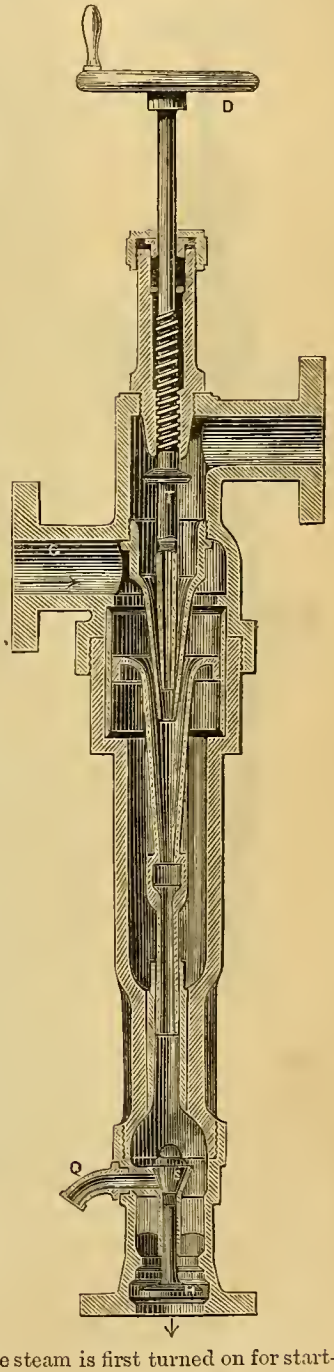
Figs. 5 and 6.




"The mode of working the instrument is as follows:—The waste-cock K being first opened, the supply of water admitted from the tank is allowed to flow out through the waste, and the steam being then turned on by the handle D, an immediate increase takes place in the volume of water escaping at the waste-cock, showing that the jet has been established. The waste-cock is then closed, and the water flows into the boiler through the valve H. In case there should be too much water admitted to the combining cone B, the superabundance will be driven into the overflow-chamber below the piston E, and will raise the piston, so as to diminish the angular space between the combining cone B and the steam cone A, and thus reduce the water supply until the quantity admitted is in exact proportion to the supply of steam. The relative positions of these cones will then remain the same until some change takes place in the pressure of the steam. Supposing the pressure of the steam in the boiler should increase, so that a larger quantity of steam is discharged through the steam cone, the increased velocity of the jet will carry along with it into the boiler some of the water which had previously escaped through the opening J into the overflow-chamber, and will thus produce a partial vacuum under the piston; the pressure of the water will then cause the piston to recede from the steam cone and admit more water, until the proper proportion is again established. At the junction of the water-branch G with the main body of the injector, a small valve L is provided (fig. 5), opening outwards; and the escape of steam from this valve gives warning that the injector has ceased working from want of water, similarly to the escape of steam from the overflow-pipe in Giffard's original injector.

"In many bodies, such as those having a small water and steam capacity compared with their heating surface, and where the demand for steam is very irregular, the variations in the steam pressure are considerable and frequent, and the amount of attention required for regulating an ordinary injector becomes somewhat inconvenient; under such circumstances the arrangement now described for rendering the injector self-adjusting has been found extremely useful. It is evident that this arrangement of injector does not permit any overflow to take place after the injector is once started. Also, as no air can get admission to the receiving cone of the injector, in consequence of there being no open overflow-pipe, the entering water-jet is not impeded in its progress by the contact of air tending to enter with it. In injectors having an open overflow, air can gain access to the entering water-jet, and the quantity of water passing into the boiler is consequently diminished.

Fig. 7.



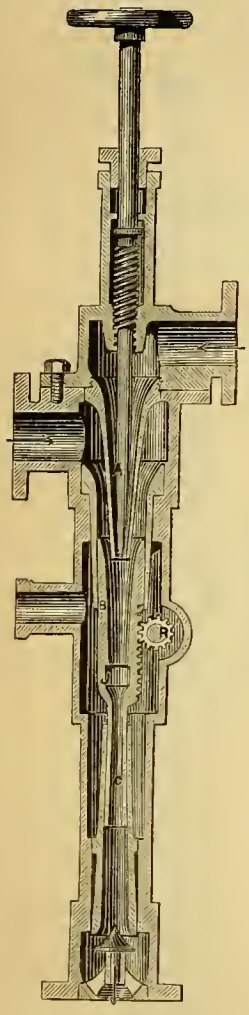

"An arrangement for rendering the self-adjusting injector self-starting has also been contrived, in order to obviate the necessity for opening and closing by hand the waste-cock K, fig. 5; for when this cock has to be opened and closed by hand by the attendant at each time of starting the injector, it increases the number of manipulations, and may, therefore, perhaps be considered as a slight objection to the instrument in that form. In the improved self-starting injector, shown in fig. 7, the spindle of the boiler valve H carries a smaller conical valve S, which, when the injector is not at work, is always kept open by the pressure of the boiler upon the valve H. When, therefore, the steam is first turned on for starting the injector, the water is at first allowed by the valves to escape through the waste-pipe Q; but as soon as the jet is established, the valve H opens to the boiler, and, at the same time, closes the conical valve S, and stops the escape through the waste-pipe, as shown in fig. 7. This arrangement has the advantage, not only of rendering unnecessary the opening and closing by hand of the

waste-cock, but also of showing very clearly when the injector ceases working; because, when that happens, the boiler valve H is closed by the back pressure from the boiler, thereby opening simultaneously the valve S, and allowing the steam and water to escape through the waste-pipe Q."

The rack and pinion injector, which has come extensively into use, is shown in section at fig. 8; and its construction, as well as general arrangement, is so obvious as to require no explanation at our hands.

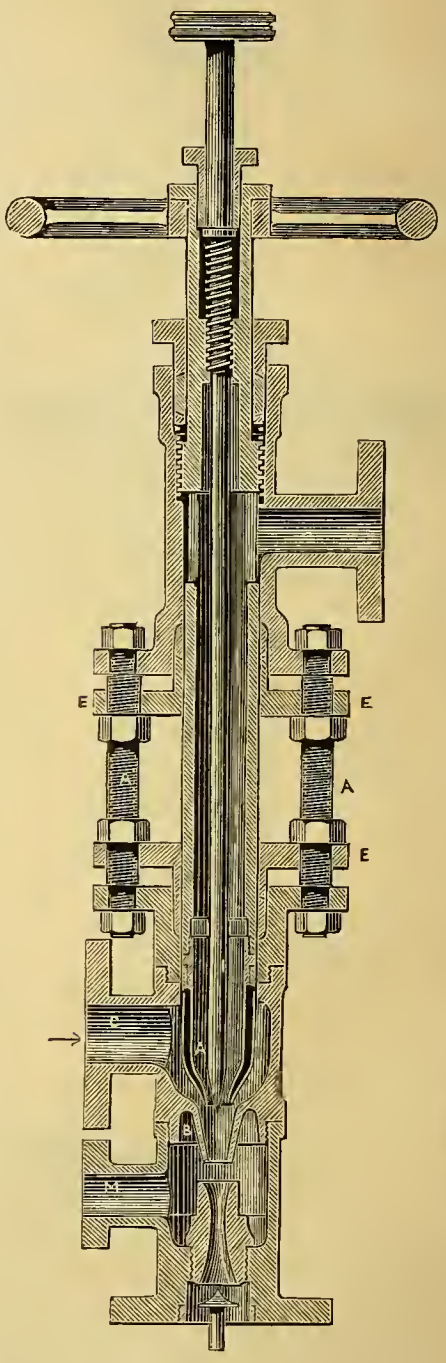
Up to the time we have now reached in our record, difficulty had been experienced, from the arrangement of the injector, in keeping the packing round the steam-passage sufficiently tight; and owing to it being situated, in the earlier forms of the instrument, a long way inside the outer casing, it was awkwardly placed to get at for adjustment. This led Mr. Barclay to divide the outer casing into two parts, as shown at fig. 9, held together by the studs A, thus leaving the central part of the steam-passage exposed; and provided with two glands E, which enabled the packing around the passage to be easily got at without the necessity of taking the instrument to pieces, as had formerly been the case.

Fig. 8.



From what has been said of other instruments, the several parts of that now referred to will be easily understood. The introduction of the glands E at the centre of the instrument had the effect of increasing the number of parts in the instrument; and it was further sought by Mr. Barclay to devise some other mode of packing the adjustable steam-passage under the previous simpler forms of the instrument. This was effected by changing the nature of the packing from hemp to metal. The metallic packing may be applied in various forms, of which one is composed of conical resilient rings, the maximum and minimum diameters of which fit or correspond to the diameters of the annular space to be packed. Rings of this nature are shown detached at figs. 10 and 11, of which fig. 10 is a transverse section and fig. 11 a plan. The rings are formed in pairs, the inner rings being marked *a*, and preferably formed of gun-metal, and the outer ring marked *b*, a compound or mixture of metal similar to what is well known as yellow brass. The inner ring *a* is thicker than the outer ring *b*, and the inner ring has narrow slits or openings cut in it with a saw, as indicated by the lines *c* at figs. 10 and 11. The splits or openings are formed alternately long and short, as shown at fig. 10; and the object of the splits, as well as the alternation of their lengths, is to ensure a more complete elastic action. The diameter of the split ring *a* is such that the edge of the larger end of the cone fits closely to the interior of the casing B of the injector or ejector, as shown at fig. 12, which is a transverse section of that portion of an instrument wherein the packing now under consideration is situated; and the diameter of the outer ring *b* is slightly larger than the interior of the casing, so that when the steam-passage, with the packing rings soldered to it, is placed in the instrument, the rings *a* and *b* are compressed by an amount equal to the thickness of the outer ring, or, in other words, to the extent by which the diameter of the outer ring exceeds the interior diameter of the casing. As the steam is admitted to the instrument by the branch D, fig. 12, it acts upon the inner packing I, and its pressure tends to force the rings 1 and 2 more closely against the casing B, thus making the joint as tight as practicable. The two rings 1 and 2 are accurately fitted together, so that no leak or blow may occur between them; and, for the purpose of diminishing the chances of a blow taking place at the packing, as well as for the further object of providing a long and steadier bearing or support for the steam-passage, two other similar pairs of rings are shown applied below those to which we have referred. This packing has been used by Mr. Barclay since the middle of 1867, and we believe that during the whole of the time since elapsed it has not required to be examined; and the joint has by it been maintained tight, showing indeed that no appreciable wear has taken place. Little wear, indeed, could scarcely be expected to have occurred; for, in the instruments to which it is applied, the passage needs only a slight and slow longitudinal movement for adjusting its position; whilst, from its delicate nature, obviously much wear would occur were it applied to the older form of the injector, in which the passage was adjusted by being screwed round for the purpose of advancing the nozzle forwards or drawing it backwards; in which case the edge of the packing rings would rub over a comparatively large surface for only a very slight longitudinal adjustment of the nozzle.

Fig. 9.

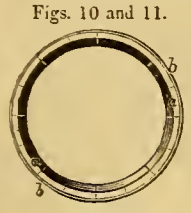


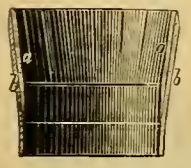

Some three years and rather more after the date of Mr. Barclay's patent of 1864, for injectors, ejectors, and condensers, Mr. Alexander Morton obtained Letters Patent for what is stated in the title as "Improvements in the lateral action, or induction of fluids, and in the apparatus or mechanism employed therefor;" a title we consider but little calculated to signify that the subject-matter of the invention really referred to locomotive engine-blast pipes, injectors, condensers, and fluid elevators; yet certain arrangements of these severally constitute it.

The term "lateral action of fluids" corresponds to what we have in former articles designated the *attractive* action of a fluid or liquid escaping through an orifice contiguous to or co-axial with another orifice through which another fluid or liquid may be drawn by the agency of the former; and, as a term, it was known and used

long ago by Venturi and others, who investigated the laws of such fluid attractions. But our readers, some of whom have, no doubt, of late heard of "Morton's ejector-condenser," will be curious to know something more safe and certain as to its peculiarities, if there be any such, than appear to have yet transpired through the columns of the engineering press. A considerable controversy has been going on for some time as to the novelty of Morton's ejector-condenser, and whether that in any respect it is different from or similar to Barclay's ejector-condenser of 1864. With this, however, we have nothing to do, our object being the placing of facts, impartially, before our readers, and leaving them to draw their own conclusions.

Figs. 10 and 11.

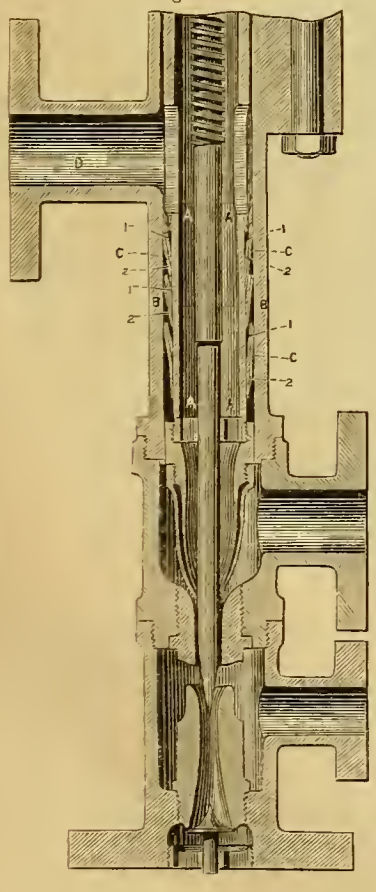




Three forms of Morton's apparatus are shown at figs. 13, 14, and 15, consisting of an outer casing provided with three branches A B C, through which water or steam may be admitted, according to the terms of the specification, in any order.

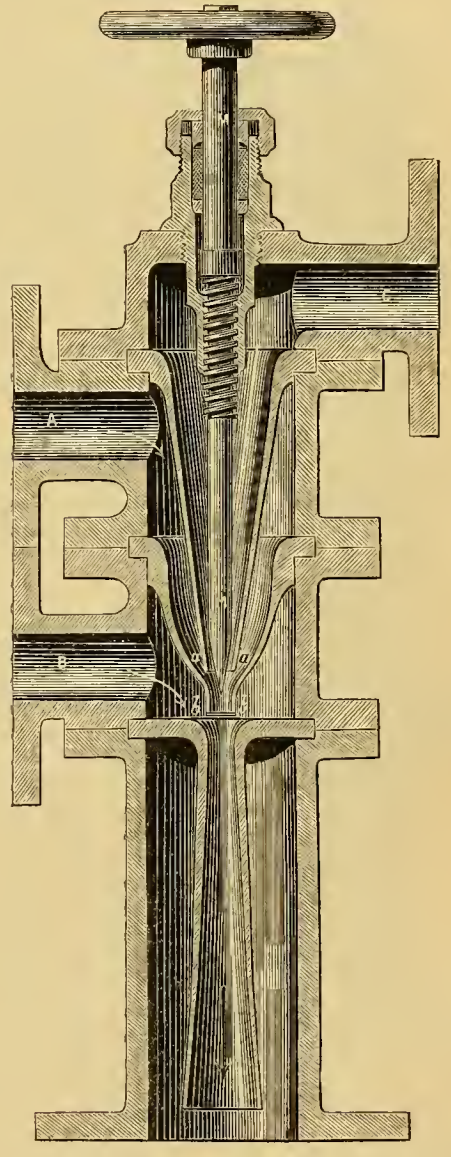
It appears to us that the only difference between the instrument illustrated at Plate V., and that now shown by woodcut fig. 13, is that whilst, in the former case, the nozzles *a* and *b* are adjustable in position, so that the areas of their orifices can be regulated according to the quantity of steam requiring to be condensed, in the latter case the nozzles *a* and *b* are fixed, so that the instrument is capable of working efficiently with an *uniform* quantity of steam only. Now it has, we believe, been ascertained, although sometimes contrarily stated, that *intermittent* blasts of a gaseous fluid, such as the exhaust steam escaping from a steam-engine cylinder, are not capable of maintaining a *continuous* flow of liquid in an apparatus wherein the attractive action of the former impels the latter, and that unless the succession of impulses of the blasts is so rapid as to produce, practically, an unbroken flow of the fluid, the flow of liquid is "lost." We presume, therefore, that this circumstance led Mr. Morton to make the central spindle of the ejector *hollow*, as shown at M, figs. 14 and 15, and connect it direct by a pipe with a steam-boiler, in order that any deficiency in the quantity of steam supplied from the exhaust-pipes might be made up by live steam taken direct from the boiler; for although the hollowed central spindle is called, *simpliciter*, a "starting-jet," and it is stated that the escape of steam through it is stopped as soon as the exhaust steam is admitted, by the self-acting piston valve X in fig. 14, yet the report is now current, although we are not sure to what degree reliable, that this hollowed central spindle is not a "starting-jet" merely; for we have heard it said by some persons that steam is almost always, if not always escaping through it; and hence is attributed the rapid loss of steam from the boiler of a small steamer for the Tiber, built on the Clyde and tried there a few weeks since. On the occasion referred to the loss of steam was such, that one of the engines had to be shut off during part of the trial, the boat being propelled by the other alone; at least we learn so from the reports in the Glasgow newspapers at the time. Now, if it be true that the steam was taken direct from the boiler and condensed, where is the alleged superiority in the ejector-condenser over the old injection-condenser of James Watt, still less over the surface-condenser and their accompaniment the air-pump?

Fig. 12.



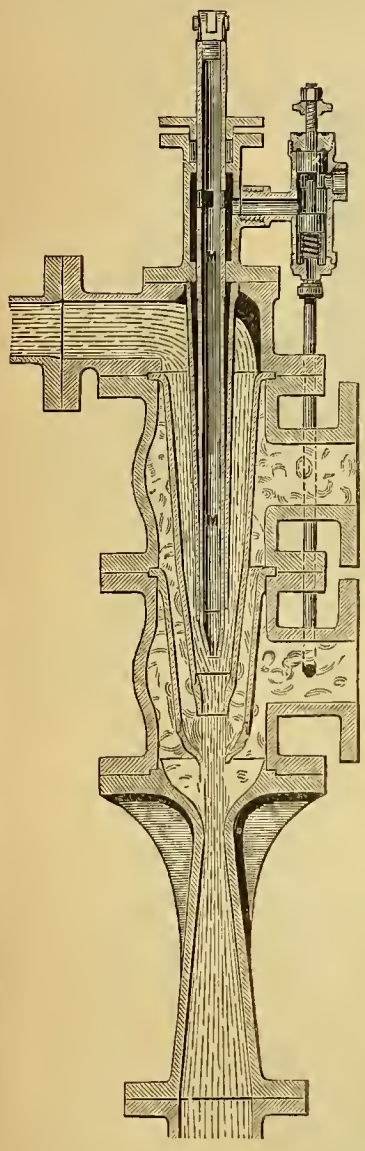
So far as we can ascertain from any of the experiments which have been made, it does not appear that any means have been adopted to ascertain the quantity of steam taken direct from the boiler by the so-called "starting-jet," and, in fact, until this is measured, we cannot know anything positive as to the efficiency or inefficiency of the apparatus. But to ascertain the abstraction of steam in this way is a most difficult problem. At present we have no instrument in existence which could be applied for the purpose of mechanically measuring it, and in attempting to get at the value by calculation we could only approximate the true quantity; in fact, the real numerical result would of necessity be circumscribed with such large limits of error as to be practically unreliable, even by making full use of factors of correction. Hence, we do think that at present there is no ground whatever for pronouncing the ejector-condenser a more efficient condenser than any of those which are doing useful service, and well tried in every part of this

Fig. 13.



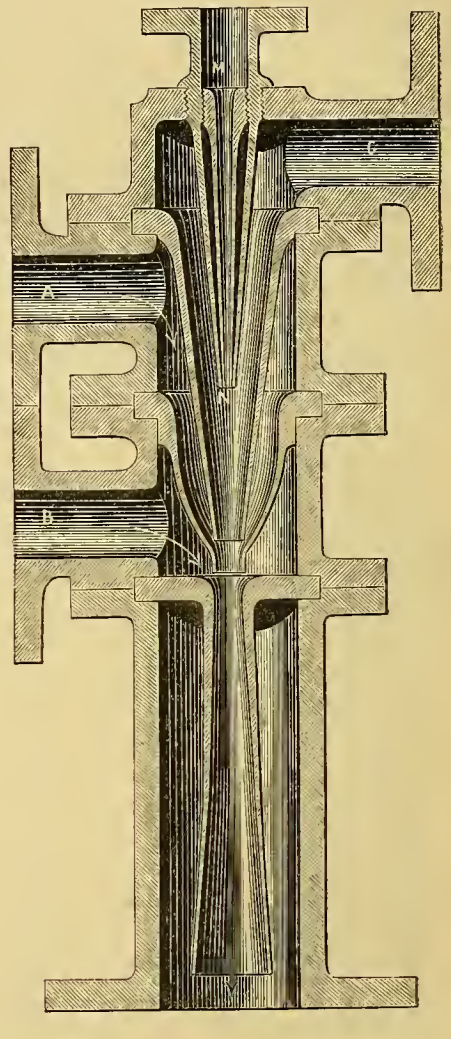
globe where steam navigation has found its way. On the question of first cost, no doubt the economy is considerable; yet if it be true that the starting-jet is constantly or only at intervals drawing off large quantities of steam direct from the boiler, and that the energy therein is destroyed without allowing it to do useful work in any form whatever, of what use is it to mention even the economy of prime expenditure? We believe that engineers have begun to doubt the working economy of the apparatus; and until it is satisfactorily demonstrated that live steam is not drawn off from the boiler in quantity and at once condensed, not only shall we ourselves, but engineers in number will remain sceptical as to the working cost in expenditure of steam, which, in other words, means expenditure of fuel. In Morton's instrument the space between the exhaust-port and the nozzles is, we understand, so small that the whole of the exhaust steam is at once brought into contact with the water-jet and instantly condensed; so close indeed is it said to be that, however rapidly the engine may be working, we should presume that, from the instantaneity and entirety of the condensation, the pulsations of the blast would produce a sensible intermittence in the flow of steam; and our readers will remember that we have before alluded to the circumstance that it is not satisfactorily demonstrated that sensibly intermittent impulses will produce a *continuous* jet of liquid at the water-nozzle. This led Mr. Barclay to turn his attention to devise some means whereby the intermittent exhaust steam might be caused to produce a sensibly constant flow of water without abstracting steam direct from the boiler: this he effected by introducing a large receiving chamber between the exhaust-port and the condenser, in which the steam is reduced to as low a pressure as the condenser is capable of forming a vacuum, or say to (—12) to (—14 lbs.) per square inch, so that the entire quantity of steam is not close enough to the water-jet to be at once condensed, and consequently there is a sensibly constant, but extremely attenuated, flow of steam from the receiving chamber.

Fig. 14.



We now proceed to describe the ejector-condenser, arranged with the intermediate receiving chamber. Fig. 1, Plate VI., is a vertical section of one arrangement of the apparatus. A is an exhaust-pipe communicating with the exhaust-port of the engine cylinder, and B is a receiving and equalising chamber into which the exhaust steam escapes, so as to equalise, that is, to diminish as much as possible any sensible intermittence in the flow of steam through the condensing apparatus, without producing any appreciable back pressure upon the piston of the engine. D is the outer casing, into which is fitted an adjustable steam nozzle E, connected to the rod N, passing through the stuffing-box O, with a screw and hand-wheel P, supported by pillars Q, so that the annular space *a* between the nozzles E and F may be increased or diminished at pleasure. At the bottom end of the casing D there is fitted a water nozzle F. The water for condensation is admitted through the branch pipe G, from a tank or other source, and passes through the nozzle or condensing passage F. C is a vacuum chamber into which the nozzle F and the throat H extend, and through which the condensed steam and injection water pass to the chamber I, through the water-locked valve J, and the water overflows by the pipe K. L is a pipe connecting the chamber B with the vacuum chamber C. The pipe L is also provided with a cock M, so that the communication may be opened or closed at will.

Fig. 15.



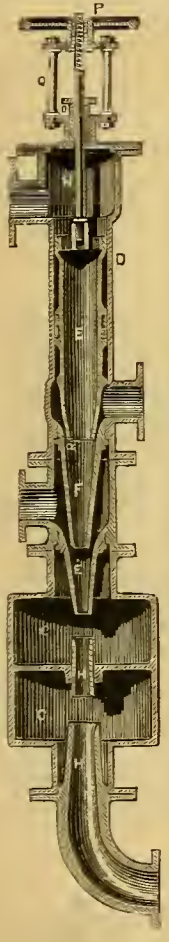
The working of the apparatus is as follows:—The exhaust steam, on issuing from the engine cylinder, passes through the exhaust-pipe A into the equalising chamber B. The steam passes from the equalising chamber B to the nozzle E by the branch R, on arriving at the end of which it comes in contact with, and is condensed by, the water on its issuing through the annular space *a*. The condensed steam and water now flow through the nozzle or condensing passage F and the vacuum chamber C into the throat H, and the water rushing from the nozzle F through the throat H tends to exhaust any air or vapour which may have collected in the chamber C, and the equalising chamber B. The water and condensed steam next pass through the valve J into the chamber I, and overflow by the pipe K, from which the water may be collected in a tank, to be drawn off to supply the boiler with feed water.

Fig. 2, Plate VI., is another modification of the condensing apparatus. In this case two connections R $R^1$ are formed between

the equalising chamber B and the casing D. The steam entering by the upper branch passes through the nozzle E, at the bottom of which, and on entering the nozzle F, it comes in contact with, and is condensed by, the injection water entering by the annular space *a*, between the steam nozzle E and water nozzle F. The condensed steam and injection water now pass through the nozzle F into a second steam nozzle E′ (which forms a second condensing chamber or passage, and renders the action of the apparatus more perfect), and meets the steam entering from the equalising chamber B by the bottom branch R′, the quantity of steam passing through which may be regulated by the valve S. The whole condensed steam and water now pass through the second steam nozzle E′, into the throat H, and through the chamber I by the valve J.

Fig. 16, woodcut, is another modification of this apparatus, constructed in the same manner as shown in fig. 2, Plate VI. ; with this exception, that a double vacuum chamber C C′ and two throats H H′ are employed. The water, after passing through the first throat H, has still a considerable velocity, and in passing through the second vacuum chamber C′ carries the air with it and forms a partial vacuum therein, which assists the vacuum in the first chamber C.

Fig. 16.




Under another arrangement the instrument constituting the condenser is made to act intermittently in place of continuously, as in that above referred to. One of the intermittently acting condensers, or "blow-through condensers," as they are termed, is shown in section at fig. 3, Plate VI. ; and it may here be mentioned that this arrangement of condenser requires the steam to be exhausted above the atmospheric pressure. The branch A is that to which the exhaust-pipe of the engine is connected. The steam on entering the instrument passes partly into the branch B, and blows open the valve C, whilst that part of the steam which does not pass out through the valve C escapes down the chamber D, and blows out the water contained in the lower part thereof, through the valves E, into the surrounding cistern. At the upper part of the instrument the branch G is situated ; it is connected to a cistern of water which flows in and fills the chamber H, in the bottom of which the valve or clack I, attached to the rod or spindle K, is fitted to a correspondingly formed valve-seat. The spindle K is connected by rods to a cam or eccentric driven by the engine, so that the valve I is intermittently lifted, and then allowed to fall and close on its seat. The chamber L is that in which the feed water is heated ; its upper part above the perforated plate M is connected to a water cistern by a pipe coupled to the branch N. The water falls into the cistern L through the perforations in the plate M.

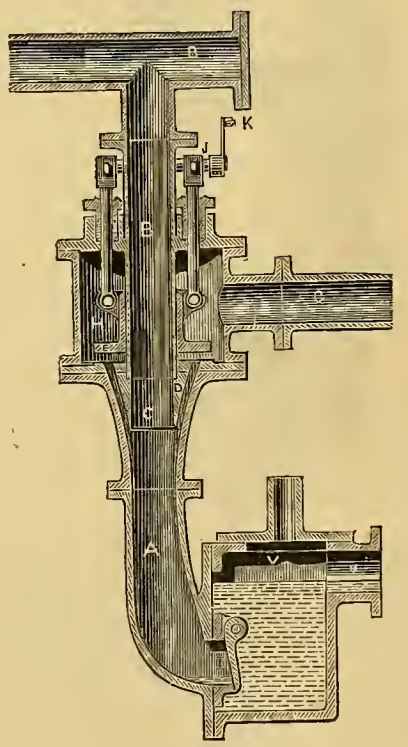
The action of this form of blow-through condenser is as follows :—The part of the exhaust steam which opens the valve C is instantly condensed on coming into contact with the water contained in the chamber L. The water is thereby heated and intended to be employed as feed-water for supplying the boilers, or for any other purpose. The heated water escapes by the passage O through the valve P, into the cistern Q, and it may be either pumped or drawn off through the branch R, or allowed to overflow through the branch S. Directly that the part of the steam which passes into the lower part of the condenser comes into contact with the water therein, it blows it out through the valves E, and at the same instant the valve I is lifted, which allows cold water to fall through the lower part of the condenser, which instantly condenses any vapour that may remain therein ; at the same time it fills the lower part of the condenser, in readiness to be acted upon, and blown out by the steam at the next exhaust.

As the engine is in action, the operations now explained are continuously repeated.

Fig. 4, Plate VI., is an enlarged section of the lower part or valve-box of the blow-through condenser, given here for the purpose of showing its construction more clearly than is indicated at fig. 1. The valve-box A, fig. 4, is square in plan, with a rectangular opening B at either side, closed by flap-valve C. The lower part of the valve-box is of pyramidal form, with the sides of the pyramid slightly curved as shown at D, and the hollow underneath is filled in with Portland cement or other material. The valves C are fitted with stops, so that they may not open more than a certain fixed distance. The stops may be applied in various forms, two of which are shown at fig. 2 at E and F respectively. The valve C is lined with india-rubber as shown at *a* and *b*, fig. 4 ; it being held firm and close to the valve C by an interior plate G held by rivets H. It is preferred to construct the chief parts of the instrument with air spaces, or in any other way to reduce their tendency for conducting heat. To this end, an air space is shown at fig. 3 by the dark shading at the sides of the chamber H.

Fig. 17, woodcut, is a vertical section showing another modification of the condensing apparatus as it may be applied to condense the exhaust steam of steam-engines. A is a condenser, which communicates with the exhaust-port of the engine by the exhaust-pipe B, to the bottom end of which a nozzle C is fitted, through which the exhaust steam passes to the condenser A. The water or condensing liquid passes into the condenser by the annular space D ; its admission being regulated by the valve E, which is opened and closed by the rods F, operated by a wyper shaft J, provided with a crank K. The condensing water is contained in a tank, communicating with the annular chest H, into which it flows by the pipe G. The condenser is supplied with a "blow-through" valve opening into the chest V, which is provided with an overflow-pipe U, through which the water used in condensing the steam may be drawn off and used for any purpose, or allowed to run to waste.

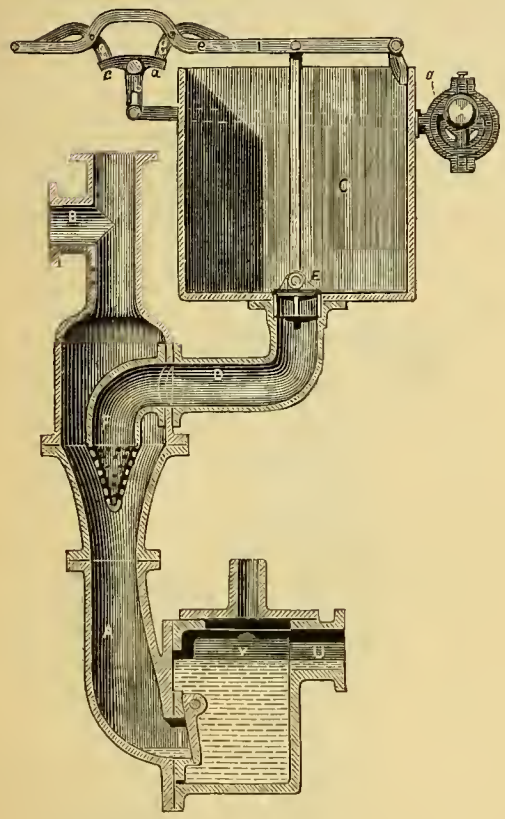
Fig. 17.



The working of this arrangement of the condensing apparatus is as follows :—When the exhaust-valve of the engine is opened, the exhaust steam escapes down the pipe B and through the nozzle C into the condenser A, where it comes in contact with the water in the condenser and forces it through the valve I into the chest V, part of the steam being condensed in consequence ; and the remainder is condensed by the injection-water admitted through the annular space D during each lift of the valve E.

Fig. 18 (woodcut) is a vertical section showing another modification of the apparatus. A is a condenser ; B the pipe leading from the exhaust-port of the engine cylinder ; C is the cistern containing the water which escapes into the pipe D during each lift of the valve E ; thence it passes through the perforated pipe or rose

Fig. 18.



F into the condenser A ; the valve E is operated by an eccentric *a* actuating a crank *b*, on the axis of which two tappets *c* and *a* are keyed, which lift the lever *e* by acting upon the pawls *f* and *g* ; as soon as the cam *c* has passed the point of the pawl *f*, the lever *e* drops and closes the valve E, and on the return stroke the cam *d* lifts the pawl *g* and opens the valve ; at the same time the cam *c* passes under the pawl *f*, which is centred on an axis, and is ready for another lift. The action of this modification is similar to the preceding, and therefore need not be further referred to.

In concluding this paper, we may mention that Mr. Barclay's blow-through condensers are supplied to the Coltness Iron Company and elsewhere in Scotland, whilst preparations are being made to apply them to several engines which have hitherto worked with the ordinary injection-condenser.

We shall next month speak as to the performance of these condensers.—V. D.

*(To be continued.)*

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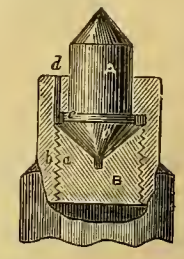
## RECENT PATENTS.

### RATCHET AND CRANK BRACES.

ROBERT FRANCIS DRURY, JOEL EATON WALKER *and* WILLIAM GEORGE WALKER, *Sheffield.—Patent dated October* 2, 1868.

THIS invention consists, essentially, in the application and use to and in crank and ratchet braces, lathes, and other tools or apparatus requiring "centres" or pivots of rotation, of loose centres, in lieu of fixed centres as heretofore ; the object being to reduce friction, and thereby increase the durability of the "centre." The improved "centre" may be made of steel, gun-metal, or other suitable hard metal, alloy, or mineral substance, and is double-pointed, the inner point being free to rotate in a female centre, which may be either fixed or movable. These loose centres may obviously be constructed in various forms, according to the tool or apparatus to which they are to be applied, but, in all cases, they are left perfectly loose or free to revolve within the box or holder containing such loose centre. The invention will be readily understood on reference to the annexed engraving. A is the double-pointed loose centre, B the female or cup centre or seat, which is removable from the brace, it being provided with an external screw-thread *a*, screwing into an internal screw-thread *b* made in the head of the brace as shown. If preferred, the cup centre or seat B may form a part of the brace-head itself. In all cases the seat B has a conical recess formed therein for the reception of the inner point *c* of the loose centre A, and a lubricating opening *d* is formed in the brace-head for the introduction of oil or other lubricant between the loose centre and its seat. The main portion of the loose centre A is made cylindrical, and an inner shoulder or head *e* is formed thereon to prevent it from dropping out of its place. The loose centre works in the head of the brace itself, the centre A being inserted and removed through the interior of the brace-head from the rear end thereof, the cup centre B being first removed. Under another arrangement a steel or other hard-metal bush may be screwed on to the brace-head for the reception of the loose centre, which latter is removed and replaced from the front end of the brace by first unscrewing and removing the bush. Further, the loose centre may be made slightly tapered or expanded towards its inner end, which answers the same purpose as the shoulder or head *e*, the centre being removed and replaced in the same way as already described.



## APPARATUS FOR CLEANING GRAIN.

JOHN HENRY JOHNSON, 47 *Lincoln's Inn Fields; a Communication from* SIMON HOWES *and* ALPHUS BABCOCK, *New York.—Patent dated August* 17, 1868.

THESE improvements relate to what are commonly known as "smut" machines for removing dust, "smut" balls, and other refuse or foreign bodies from grain. According to this invention, the "smut" machine is provided with two stationary vertical hollow cylinders placed concentrically, in the inner one of which revolve a set of scouring beaters attached to a vertical shaft, which shaft carries near its upper end a revolving suction fan working in a chamber situate above the two cylinders aforesaid, and communicating therewith by a central mouth or opening. This chamber is provided with a discharge spout at its circumference for the discharge of the currents of air produced by the fan, along with the impurities removed from the grain by the scouring beaters. On rotating the main vertical shaft, a central draught of air from the bottom of the stationary cylinders is forced or drawn upwards through the inner casing or cylinders enclosing the scouring beaters, and also between such casing and the outer casing or cylinder of the machine or mill. Both these upward currents of air unite in the chamber containing the fan before referred to, entering by the central mouth or opening in the bottom of such chamber, and passing out by the lateral spout or mouth.

Fig. 1 of the accompanying engravings is a vertical transverse section, and fig. 2 is a transverse section taken through the line $x\,x$ of fig. 1. A represents an upright rectangular frame, supported within the top of which is a horizontal fan-box or chamber B provided with a spout B′ for discharging the currents of air generated by the suction fan C. This fan is secured to a vertical spindle C′, which extends down through the centre of the frame A, and is supported at its lower end in a step $a$, as shown in fig. 1. A short distance below the fan-box B is a horizontal floor $b$, and below this floor $b$ is the perforated cylindrical case E, which contains the rotating beaters F. This case or cylinder is confined between two stationary heads $c$ $d$, the upper one of which is about equal in diameter to the case, but the lower one $d$ is of sufficient area to form also the floor of an outside solid casing or jacket G, between which latter and the circumference of the perforated cylinder E is a space $g$, which is open at its base as shown at $i\,i\,i$.

Fig. 1.

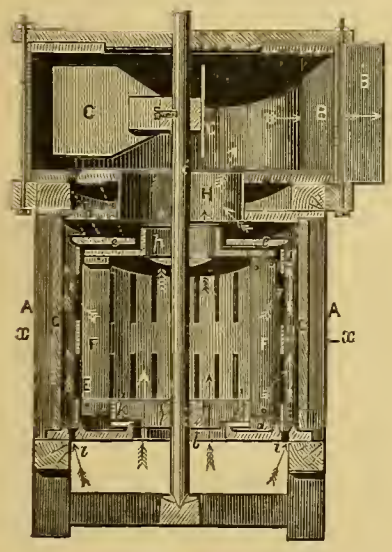
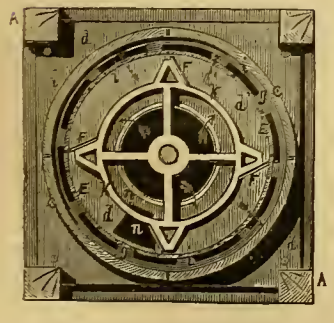



Fig. 2.




The upper head c of the cylinder E has a central opening through it, and directly above this opening there is an enlarged throat H communicating with, and forming an extension of the fan-box B, as shown in fig. 1, which throat is a common exit for the chaff, smut-balls, and dust which are carried upwards from the interior of the casing E and through the space $g$ surrounding this casing, as indicated by the arrows in fig. 1, which arrows indicate the direction of the currents of air through the machine. The space $g$ is continued over the casing head $c$, where it is contracted by the throat H; hence it will be seen that the rotation of the suction fan will cause the air to rush into the openings $i\,i$, and also through the central opening $j$ in the plate $d$, and ascend towards and through the throat H into the fan-box.

The beaters or scourers F consist of narrow strips secured tangentially to the circumference of two circular heads K K′, the lower one of which is keyed to the spindle C′, as shown in fig. 1. The plates F are bolted at their extreme ends to projections formed on their respective heads K K′, and these heads are constructed so as to allow the air rushing in through the central opening $j$ to pass freely through them and escape through a like opening $p$ at the upper end of the casing; the upper head $k$ has a central flange projection from its upper surface, which surrounds the opening $p$ through the head, and that part of this head which surrounds this flange is solid for the purpose of receiving the grain falling through the hopper or spout, indicated in fig. 1 in dotted red lines, upon the upper surface of the head, to be ejected therefrom against the sides of the perforated casing, where the grain will be subjected to the beating and blast action of the rotating scouring plates.

The operation of the scouring plates upon the grain, together with the central upward blast through the scouring cylinder, will separate the smut-balls, chaff, and other light substances from the grain, which latter will fall by its superior gravity and escape from the machine through the opening $n$ in the base-plate $d$, whilst the lighter substances will be partly carried directly upwards into the fan-box B by the central draught, and partly ejected through the casing E into the space $g$, to be similarly acted upon by the currents of air rushing up through this space.

The scouring plates themselves generate currents of air, indicated by the arrows pointing through the perforations in the casing E, and thus the dust and large quantities of the foreign substances will be thrown directly off into the space $g$, where they will be carried directly off through the fan-box.

By this arrangement a free unobstructed passage is obtained for the air directly through the centre of the scouring cylinder, and communicating at the top thereof with the fan-case; and a free passage is also obtained for the air surrounding the scouring cylinder to ascend into the fan-box, both of which passages unite in one common exit throat, which constitutes a portion of the fan-box above the scouring apparatus. In other words, the fan-case is so constructed and applied in the machine that the conflux of air will be at a point directly within the body of this case, or within a contracted central extension thereof; and by this means an eddy will be prevented from taking place, in consequence of the following together of the two currents over the central opening $p$ of the scouring apparatus, and hence the heavier refuse substances will be prevented from falling back into the casing E.

By this arrangement it will also be seen that no smut-balls, dust, or any portion of the refuse from the grain can find a lodgment or get intermixed with the grain after once separating from it. The fans are brought in a more direct relation to the scouring apparatus than hitherto, and the refuse is wafted off by the fans immediately it is separated from the grain.

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## OBTAINING MOTIVE POWER.

GEORGE WARSOP, *Nottingham—Patent dated September* 8, 1868.

THIS invention relates to improvements in obtaining motive power by means of air and steam.

The machinery which the patentee employs consists of a steam-boiler and an engine (which may be similar to those now in use); the engine works an air-pump or pumps, drawing in cold air and forcing it through a coil of pipes or other suitable chamber, heated by the furnace; and from this heated coil or chamber the air passes into the boiler, and is caused to rise in a finely-divided state through the water therein contained. The air and steam together pass from the boiler to work the engine. The patentee

prefers to open and close the valves of the air-pump at suitable times by means of cams, as the pumps then work more efficiently than when the valves are self-acting. The heating of the air after it leaves the pump or pumps may be effected by passing it through hollow fire-bars ; or apparatus such as is now employed for superheating steam may be used for heating the air. The air is caused to be finely divided as it passes through the water by means of partitions of wire-gauze or other open-work or perforated material.

## LAW REPORTS.

LACE MACHINES.—BATES AND REDGATE'S APPLICATION BY PETITION FOR PATENT.—Court of Chancery, before the Lord Chancellor. Stephen Bates and William Redgate, of Nottingham, petitioned the Lord Chancellor to affix the Great Seal to Letters Patent applied for by them on October 2, 1868, for improvements in lace machines. The petition was opposed by Joseph Hume Bertie, on the ground that he had already obtained letters patent for substantially the same invention. The affidavits showed that the opponent Bertie applied for his patent on November 2, 1868, a month after the application of Bates and Redgate; but he allowed no unnecessary time to elapse before proceeding to procure the Great Seal to be applied to his patent, which he did in fact obtain in January 1869. Bates and Redgate delayed their application for the affixing of the Great Seal until March 19, 1869. There was no point made in argument as to which invention was in fact of prior date, both being stated to have been made in June 1868.

Mr. Webster, Q.C. (Common Law Bar), and Mr. Everitt appeared in support of the petition ; and Mr. Grove, Q.C., and Mr. T. Aston (both of the Common Law Bar) appeared for Mr. Bertie to oppose it.

The Lord Chancellor felt obliged to refuse the petition. He thought that an inventor who had filed a provisional specification after another inventor had filed one on the same subject-matter, but who had succeeded in procuring his patent to be the first sealed, was in the same position as he would have been before the statute which provided the machinery of provisional specifications. The benefit which the statute intended to confer on inventors from a provisional specification was not protection against the public, but only against the consequences of imprudence on their own part, and the betrayal of confidence by their workmen and others. If they desire to have a more absolute protection, section 9 of the statute gave them the means of obtaining it by filing a complete specification, which must be published at once, and which would be a bar to any other persons seeking a patent for the same invention. The petitioner had not filed such a complete specification ; but he now contended that his provisional specification entitled him to like protection against rival inventors, and that the original wrong was in the Attorney-General allowing another to file a provisional specification. His Lordship, however, was of opinion that the Attorney-General could not have reasonably refused Mr. Bertie's application in the absence of any primâ-facie fraud. There was nothing to compel a person who had filed a provisional specification to proceed with his invention, and if the Attorney-General were to reject a second applicant on the ground of one such specification having been already lodged, the consequence might be the loss for a year or more to the public of the fruits of the ingenuity of many minds which commonly were working together in regard to the same invention. It had been complained, indeed, on behalf of the petitioner, that an inventor would be helpless on Mr. Bertie's contention. But this was not so. A second inventor must advertise, and one who had filed the first provisional specification ought to keep a watch over the advertisements, and on observing an invention advertised of an apparently similar character to his own, might enter a *caveat*, which would make it incumbent on the Attorney-General to decide which was the prior inventor. This opportunity the petitioner had not availed himself of, and his Lordship could not now protect him from the consequences of his omission by antedating his patent. If there were anything in his patent not covered by Mr. Bertie's patent, it was quite proper that he should have a patent for that; but the Lord Chancellor could not seal a patent which would interfere with the patent rights of Mr. Bertie, who had now possession in his favour. As, however, the matter was one of first impression, it was not a case for giving costs. The petitioner might have his option, either to have his petition dismissed without costs, or the order might be that there should be no costs of the present hearing, and the petitioner might have leave to apply to the Attorney-General for a patent to be dated the 19th of March 1869, being the day when he applied for his patent, but which must not comprise any ground covered by Mr. Bertie's patent.

ELECTRIC BELTS.—PULVERMACHER *v.* HAMMOND.—Court of Chancery, before Vice-Chancellor Sir W. M. James. Mr. Glasse, Q.C., and Mr. T. A. Roberts moved in this case to restrain the defendants, Charles Daniel Hammond and Alfred Burrows, otherwise Henry James, from an alleged infringement of the plaintiff's patent for electric belts and galvanic magneto-electro apparatus, &c., and from pirating the plaintiff's trade-mark, consisting of the words "Electricity is life," variously advertised, sometimes in blue clouds with gilt lightning surrounding it, on an illuminated sheet. Mr. Cotton, Q.C., and Mr. Graham Hastings appeared for the defendants. The plaintiff, Isaac Louis Pulvermacher, alleged that he had for twenty-two years past devoted himself to the study of electricity, galvanism, and magnetism, for alleviating bodily ailments, and carried on business at 200 Regent Street, and in Paris; that he had invented certain means of applying electricity by voltaic chain batteries and flexible bands and belts, and from 1849 to 1861 applied for and obtained patents for the same. The bill referred to these patents, and that he had submitted his invention to Sir Charles Locock, Sir H. Holland, Sir W. Fergusson, Sir J. R. Martin, and Drs. Sieveking, Quain, Clark, and Jones, from whom he received testimonials; and letters from Sir J. R. Martin and Sir Charles Locock were produced. The plaintiff then alleged that his system and inventions had met with great success, and that the defendants had for some years past carried on business at 11 Charlotte Street, Bedford Square, otherwise called Percy House, in order to make it appear that they practised at different places. The bill then set out advertisements issued by the plaintiff and defendants, in some of the latter the words "Electricity is life, by means of the patent electric belts," commencing them, and Doctor Hammond was stated as the inventor and patentee of scientific inventions, and James was stated in one of the pamphlets which they had published to be the doctor's confidential assistant. The defendant Hammond had filed a provisional specification for improvements in apparatus for the relief of bodily ailments; but that had been determined, and it was clear that there was no patentee but the plaintiff. There were affidavits by Sir Charles Locock, Sir Ranald Martin, &c. An affidavit of the defendant James was read, deposing that for two years past advertisements of both parties, plaintiff and defendants, had appeared side by side, in some of which the words "Electricity is life," did not appear in the plaintiff's but did in the defendants'. A copy of the *Boston Gazette* was produced. This had not been objected to by the plaintiff. Dr. Hammond was out of this jurisdiction.

At this stage of the motion,

Mr. Glasse, Q.C., admitted that on that evidence he could not insist upon the interlocutory injunction.

The Vice-Chancellor said he was very sorry that the public could not be protected, for poor people in this country seeing these advertisements thought they could get cured. He had a strong opinion against the defendants on their own affidavits. The motion must stand over till the hearing.

LAMPS.—PARKES *v.* STEVENS.—Court of Chancery, before Vice-Chancellor Sir William James, June 4, 1869. Mr. Thomas Webster, Q.C., Mr. Kay, Q.C., and Mr. Everitt were for the plaintiff; Mr. Amphlett, Q.C., and Mr. W. H. G. Bagshawe were for the defendant.

The Vice-Chancellor gave his judgment, or rather verdict, with reasons, in this case, which came before him upon the trial without a jury of certain issues as to the validity of the plaintiff's patent for improvements in gas lamps, and the question of infringement of such patent by the defendant in the globular lamps recently erected by him in New Palace-yard. In 1862 the plaintiff obtained a patent for improvements in gas lanterns, the improvements being stated in the specification to consist in the construction of lamps of a globular form, each piece being the segment of a sphere, while, "from the absence of apertures in the middle bead and the disposition of the metal in its upper and lower rings and ribs, which are few in number, comparatively little surface is presented to intercept the radiation of light, and consequently little or no shadow is thrown." The door of the lamps manufactured under this patent opened outwards, and was fixed by a hinge to the adjoining segmental rib. It was found, however, inconvenient in many respects, and the plaintiff after some experiments adopted a revolving or sliding door, and enclosed in a light spherical frame corresponding with the outer surface of the lamp. In the course of these experiments the plaintiff otherwise improved the mode of manufacturing such lamps, the great object of the improvements being, for which he obtained a patent in October 1865, as stated in his specification, "to produce a glazed lamp, the frame of which shall throw little or no shadow, and yet at the same time possess the requisite strength and also facilities for lighting and cleaning the lamp." The invention was stated to relate "to the construction of lamps of a class forming the subject of a patent granted to me bearing date 26th day of June 1862 (No. 1,876), which lamps are particularly applicable for railway stations or in large exposed areas, either enclosed or open." The claim sought to be protected by the patent was "the arrangement and combination of parts hereinbefore described and represented in the drawings annexed in the manufacture of railway station and other gas lamps." The defendant, who is a gas engineer, carrying on business in Southwark-bridge Road and at Glasgow, had, about the beginning of last year, under an order from Mr. Barry, the Government architect, supplied the lamps which are now placed in New Palace-yard. These lamps, which were globular in form, with revolving or sliding doors, were alleged by the plaintiff to be an infringement of his patent of 1865, and he had accordingly filed his bill to restrain such alleged infringement. The defendant disputed the validity of the patent, and denied infringement, and issues were directed for trial before his Honour without a jury, as to—1 and 2, novelty and utility of the invention patented by the plaintiff in 1865; 3, sufficiency of specification; and 4, infringement of the patent by the defendant.

The Vice-Chancellor, after stating the issues &c., said he was of opinion that the plaintiff had produced, by a skilful and ingenious arrangement and combination of the parts of the framework of his lamp, an article of manufacture of great neatness, even elegance of form, well calculated to produce the desired end: that is, the framework throws little or no shadow, while it at the same time possesses the requisite strength and facilities for lighting and cleaning. There is evidence, not contradicted, that the arrangement and combination of the parts was new. It required some thought to design it, some labour to give the design practical form and effect; and it seems to have answered better, taken as a whole, than any lamp previously designed for the same object. His verdict, therefore, on the first three issues was in favour of the plaintiff. He was, however, clearly of opinion that there could be no patent right in the substitution of a slide for a hinge, whether applied to the door of a house or the door of a carriage, or the door of a lamp or lantern, whether large or small, suspended or not suspended. The Vice-Chancellor doubted whether the plaintiff's patent is not confined to gas lamps suspended. His verdict on the issue as to infringement was therefore for the defendant.

## REVIEWS OF NEW BOOKS.

*Roads, Railways, and Canals for India.* By T. Login, M.I.C.E. 8vo.

*The Mountain-top Track; a Description of the Railway across the Blue Ridge, State of Virginia.* By Chas. Ellet, jun., C.E.

*British Railways as they Are and as they might Be.* By John Imray, C.E.

*Chemin de fer économique, par l'application des courbes de petits rayons etc.* Par J. J. Aubry. 4to. Paris, 1868.

*The Tramway Question, as applied to London and its Suburbs.* By Herbert Bright, C.E.

*On the Construction of Horse Railways for Branch Lines.* By Charles Burn, C.E.

*Metropolitan Street-Tramways South of the Thames; Explanatory Statement (on the Part of the Company).*

*The Railway Working Association (Limited).* A. P. Hobson, Secretary, 9 Victoria Chambers. In *Railway News* of April 1869.

These, and several more pamphlets which encumber our table, show that at length the æra of cheap railways, so long and so vainly looked for by those few of the engineer's profession who years ago advocated the necessity and the high importance of the system, has arrived—at the period of discussion, at least. It was but a few years back that the "great guns" of the profession, whose fame and fortunes had been made by the costly lines of the Stephensonian and Brunelian epochs, resolutely set their faces against any cheaper or lighter modification, and treated as mere impracticable fools any who ventured to hint anything to the contrary.

The change has come, not through anything that can reflect much credit on the engineering profession either. It has come mainly through the pressure of three causes. The main-trunk lines were already made, and the panic of 1866 put an end to the avocation of the railway engineers of the genuine conservative stamp. There was no more work to be had. Railways, already a longer or shorter time opened, were too many of them not over-prosperous as to dividends, and others than engineers asked, could no contrivance feed them with increased traffic, except at the ruinous cost of "branches" on the orthodox system? Railway practice, work, and experience had got to be possessed by a crowd of younger men, who understood pretty clearly the conditions of the future problem of their life occupation; and, out of work, and out of shackles with the "grave and reverend seniors," were able freely, and were urged by circumstances fully, to assert the long unpalatable views, that cheap railways could be made and ought to be made.

A good deal of vigour was given undoubtedly also to the new movement by the reiterated and clear exposition of the true principles of such lines, and of the false principles upon which locomotive haulage and traffic was and is conducted upon most of the old and heavy lines, by Mr. Robert Fairlie, C.E., and a few associated with him.

His light railway system and light engines (as to bearing on any one wheel), capable of going round the shortest curves, were well shown at Paris in 1867, and excited a great deal of attention on the part of foreign engineers, as they have at length done on the part of some British ones, who, with Mr. Fairlie, have formed the Railway Association named above.

Mr. Sharp, one of the very earliest apostles of narrow-guage and light lines, has, in Central France, quietly and silently been extending the system of cheap railways there; and now there can be little doubt but that the next ten years will see cheap narrow-guage railways, with steep occasional gradients and sharp curves, and engined on the principles Mr. Fairlie has enunciated, spreading over parts of the British Islands, and of other countries which otherwise might remain for ever without the benefits of railway communication.

Mr. Login's pamphlet is dedicated to the exposition of broad views as to the policy of a joint engineering projection and conduct of canals, roads, and cheap railways for India, each supporting, and relieving the other of part of the first cost. It is an able production by a man who obviously knows his ground by long experience.

Mr. Ellet's is a description of a railway, in point of daring, as remarkable as Mr. Fell's, and long anterior in time. It was designed for temporary use only, having a maximum gradient of 296 feet per mile, and a minimum radius of curves of only 234 feet. Notices of this remarkable work have appeared in various places, but none so complete as this, which is published by Collins, Philadelphia.

Mr. Imray deals with questions of present management and fares for passengers, on our own railways, and produces several suggestions for improvement and economy, &c., into the merits of which we cannot enter here. The pamphlet is primarily for the traffic manager and managing directors' consideration.

Mons. J. J. Aubry's *brochure*, which has been submitted by the Minister of the Interior to the Council of the Bureau des Ponts et Chaussées, and to a special commission of the Academy of Sciences of France to report upon, embraces several propositions as to details, destined to arrive at results very like those of Mr. Fairlie—viz., lighter-bearing engines and carriages, steeper gradients, narrower guages, and sharper curves, and so greater economy both in outlay and in working.

Mr. Bright develops the systematisation of a network of street omnibus tramways for London and other cities, and the earliest ripened fruit of this system is now about to drop, by the passage of the Bill of this Session for the Southern Tramway, London, of which one of the pamphlets on our heading is descriptive, and designed to explain away objections and prejudices raised by Mr. Train's unfortunate attempts of some years ago in that same district. We may say the same as respects Mr. Burn's larger and more elaborate exposition of the cost, working expenses, and profits of horse-worked railways and street trams, which contains a very fair comparative discussion as to the various forms of trunk rail proposed or adopted.

Amongst the most recent designs produced by Mr. Fairlie is one for the combination, under some novelties of constructive conditions, of the light locomotive with a very long bogie-borne passenger carriage. This form of combined engine and carriage may, no doubt, find its uses. We are, however, not quite clear as to the wisdom of combining permanently together into one, engine and carriage, for limited express services of importance, the disablement of a part being here that of the whole. Nor do we quite see that these very long carriages can adapt themselves, even under Mr. Fairlie's skilful hand, to branch railways with very abrupt curves.

Ed.

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*The Agricultural Labourer.* By J. Bailey Denton, Esq., &c. 8vo. pamphlet. Stanford, 1868.

This is a reprint of a paper read by the author at the Society of Arts. It is a discussion of the relative position of the agricultural and the mechanical labourer and craftsman throughout England, and a review of the actual state of the former, with the object of its amelioration.

Mr. Bailey Denton's opportunities of observation are considerable, and his remarks, as a skilled agricultural engineer, upon subjects as to which his professional avocations must have necessarily given him great advantages, are worthy the perusal of the landowner, whose interests are so bound up in reality with those of the *adscripti glebæ* upon his estates; for, as things are, ignorance and low wages really make the English agricultural labourer almost as much a helpless serf as if he were a real slave.

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*London Water Supply, &c. &c.* By John Taylor, C.E. 8vo. pamphlet. Spon, 1869.

This is mainly an argument against the contract supply system as applicable to London, and seems written very much as if an echo of the water companies' wish—leave us alone.

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*The Smoke Nuisance and its Remedy by means of Water; with Remarks on Liquid Fuel.* By C. J. Richardson, Architect. Pamphlet. Atchley and Co., London, 1869.

The author of this pamphlet says of it and of himself, that it is a bold attempt thus in a pamphlet of forty-seven pages to abolish the smoke of our domestic fires and flues, and the use of coal as

steam-ship fuel. We may take comfort, however, that the attempt is not likely to go beyond the printing of these forty-seven pages, or into any more practical form. The author's panacea for smoke is to give it a constant shower-bath just behind the grate, and provide means to carry into the sewers the dirty water and soot together. He seems delightfully unconscious of any difficulties in carrying out this in domestic cases, which has been made to answer in certain *analogous*, but not identical, manufacturing operations; nor of the fact that if open chimneys are "to draw," their feeble flue heat will not bear to be reduced to below 212°.

As to the few pages about liquid fuel, they are such very superficial compilation from well-known sources, with nothing in particular to attract notice, that we may pass them without any.

## CORRESPONDENCE.

☞ We do not hold ourselves responsible for the views or statements of correspondents.

### CAPTAIN LORD JOHN HAY'S ENGINE COUNTER.

TO THE EDITOR OF "THE PRACTICAL MECHANIC'S JOURNAL."

Sir,—My attention has been directed to a notice in your last number of "Captain Lord John Hay's Improved Engine Counter."

Without particularly referring to the "Counter," from your explanation that a "*stamp is combined with a self-acting or numbering apparatus*," the entire machine appears to be identical in principle with "Hill's Machine for Stamping and Counting Bank Notes," &c. privately used as an experiment (completely successful) at the Bank of England.

To prevent any mistake which may arise in regard to priority &c., and in justice to myself as an inventor, I beg to state that my machines have been in constant operation from a date long antecedent to that of Lord Hay's patent (granted Dec. 1864), and therefore claim precedence in point of originality on the subject of your notice. How far improvements may have been effected or otherwise, I do not now desire to discuss. Suffice it to say, my invention satisfactorily answers the purposes to which it is applied.

Yours truly,

DANIEL HILL,
Principal of the Accountant's Bank-Note Office, Bank of England.

233 Camden Road, N.
May 29, 1869.

### AN EARLY INJECTOR.

TO THE EDITOR OF "THE PRACTICAL MECHANIC'S JOURNAL."

SIR,—I send you a few particulars about my Injector.

In March 1856 I was appointed by Mr. C. Schiele, patentee of silent fans, turbine engines, &c., to erect an engine at Morningside for the Edinburgh and Glasgow Railway Company, on the turbine principle. We started the engine with a pressure of steam 30lbs. to the square inch. As there was no force-pump to feed the boilers, we had to lower the pressure of steam to 14lbs. on the square inch, as the turbine could not act when the pressure of the steam was above 14lbs. to the square inch. This caused me to think if some method could not be devised by which water could be put into the boiler at any pressure of steam, which resulted in the idea of conical jets.

This idea was always presenting itself to my mind until October of the same year. When Mr. Schiele and I had occasion to meet again, I laid a sketch of my injector before him, when he said that it appeared a thing likely to work. I made an apparatus for experiment and had it fixed to a locomotive-engine boiler (the name of the engine was the "Allanton," belonging to the Edinburgh and Glasgow Railway Company): this I did merely to see whether the idea was practicable or not. After being satisfied that the germ of something good was in the idea, I did nothing further in it until the year 1861, when I made another apparatus, founded on the same idea as that of 1856; but, keeping in mind the defects of my first experiment, I added a rotatory motion, by the steam acting on a wheel, raising water by the centrifugal principle, for the purpose of raising water from a greater depth than formerly. I also applied a float-valve inside of the chamber surrounding the receiving jet, for the purpose of allowing the air to escape while forming a vacuum. The valve afterwards was shut by the force of the water, thus giving a recoiling action to the receiving jet, and preventing a loss of water or any disagreeable noise while in action.

A further attachment was also made, in order to raise and force water any required height by two pipes connected parallel to each other, one for steam the other for water, with truncated steam-jets passing into the centre of the water-pipe; the jets placed at various distances according to the pressure of steam and orifice of the jets.

Glasgow, *June* 1869. WILLIAM THOMSON.

*Note by the Writer of the articles on "Injectors" &c.*

[The apparatus which our correspondent refers to is at present in our hands. We have carefully examined its arrangements, and it certainly contains the germ of Giffard's apparatus. We should doubt however if, in the form it had, that the water and steam combined so perfectly as in the injector with concentric steam and water nozzles. Nevertheless, the fact is interesting that an injector was made in this country, and in use on a locomotive-engine, long prior to Giffard's invention having been heard of; and such being the case, we hope to illustrate the same by wood-engravings in our next Part; for it is our desire to make this record of injecting and ejecting instruments practically as complete as possible, without, however, pretending to include many proposals of which the value is not known for want of trial.—V. D.]

## PROCEEDINGS OF SCIENTIFIC SOCIETIES.

### THE INSTITUTION OF CIVIL ENGINEERS.

APRIL 13th, 1869.—The paper read was on "Experiments on the Standards of Comparison employed for Testing the Illuminating Power of Coal Gas," by Mr. T. N. Kirkham, M. Inst. C.E.

APRIL 27th, 1869.—The paper read was "On the Outfall of the Humber," by Mr. W. Shelford, M. Inst. C.E.

The estuary was described as the outlet for the fresh waters from a drainage area of 10,500 square miles, or one-fifth of the whole area of England; but the present paper only treated of the Outfall, the observations being arranged under four heads. We cannot give space to the details of the papers.

### ROYAL INSTITUTION.

APRIL 16th, 1869.—Mr. W. Carruthers, F.L.S., in a lecture entitled "The Cryptogamic Forests of the Coal Period," confined his attention to a minute technical botanical description of two trees found in coal forests.

APRIL 20th, 1869.—Professor Grant, F.R.S., in his third lecture on "Stellar Astronomy," spoke principally of temporary stars. He narrated how, in 1572, Tycho Brahe discovered a new star in the constellation Cassiopeia, which star for a time was brighter than Venus, could be seen with the naked eye at noonday, and was sometimes visible through thin clouds dense enough to obscure all other stars. It was visible for about four years altogether. Another remarkable star burst out in 1604, in the time of Kepler and Galileo, who made the phenomenon a subject of close and accurate observation. Among other temporary stars, that seen in 1866, and spectroscopically examined by Mr. Huggins, was described by the lecturer. It came out in the constellation of the Northern Crown, and for some time was a conspicuous object in the heavens; in a few months it gradually became invisible to the eye, and at the present time can only be seen by the most powerful telescope. This star is not a new one, for its appearance has been noted in former times. Stars which vary in brightness regularly and periodically are very numerous in the heavens, more than 100 having been noted up to this time. Some few of these become quite invisible occasionally. Among the most interesting variable stars, Beta Lyræ, Omicron Ceti, and Algol may be mentioned; our own sun is a slightly variable star. There are some stars irregularly variable: one of the most remarkable specimens is visible only in the southern regions of the earth.

APRIL 22nd, 1869.—Professor Tyndall began this lecture on "Light" by explaining the laws governing the passage of light through lenses of different forms, illustrated by a few simple experiments with double convex lenses and candles. To show spherical aberration, or the fact that the outside portions of lenses bring rays to one focus, whilst the centres of the same lenses bring the same rays to another focus, he threw an image of the charcoal points of the electric lamp upon a screen by means of a large plano-convex lens. A confused image was the result, because of the spherical aberration of the lens. By means of an opaque diaphragm with a hole in the centre, he then used only the centre of the lens, and obtained a sharp image. Another diaphragm was next used, which permitted the rays to pass only through the outside portions of the lens, and again a sharp image was produced, but its focus was much nearer the lamp than when the central rays were employed. When the transparent substance of which lenses are made is less dense than the transparent substance outside the lens, the properties of concave and convex lenses are reversed. Dr. Tyndall also exhibited Wheatstone's little photometer.

APRIL 23rd, 1869.—Mr. E. B. Taylor on "Spirit Rapping;" or, "the Survival of Savage Thought in Modern Civilisation."

APRIL 24th, 1869.—Mr. Archibald Geikie, F.R.S., on "the Origin of Land Surfaces."

APRIL 27th, 1869.—Professor R. Grant, F.R.S., in his fourth lecture on "Stellar Astronomy," spoke of the great distance of the fixed stars, as proved by the facts that they cannot be sensibly magnified by a telescope, that they are instantly eclipsed by the edge of the moon, and that until recently the distances of none of them could be determined by parallax. In the earlier days of astronomy an attempt was made to determine their distances by the brilliancy of the light which they emitted, and in these experiments it was assumed that they were all of equal magnitude and splendour. It was resolved to compare the light of each star with the light of the sun, but as the sun and stars were never visible at the same time, one of the planets was chosen as an intermediate body. The light from Saturn was therefore photometrically measured, and knowing to some extent the quantity of light lost by absorption, the relative intensities of the light of Saturn and of the sun were determined, after which the light of Saturn was compared with the light of the fixed stars.

*Comparative brightness of some of the fixed stars.*

| Star | Light | Star | Light |
|---|---|---|---|
| Sirius | 416 | Procyon | 51 |
| Canopus | 204 | Alpha Orionis | 49 |
| Alpha Centauri | 100 | Aldebaran | 44 |
| Arcturus | 72 | Antares | 39 |
| Rigel | 66 | Alpha Aquilæ | 35 |
| Capella | 51 | Spica Virginis | 31 |
| Alpha Lyræ | 51 | Fomalhaut | 26 |

From these results it was found that our sun would have to be removed to 220,000 times its present distance to reduce it to the apparent size and luminosity of a moderately bright fixed star. When, by the perfection of astronomical appliances, it became possible to determine the distances of some of the stars by the unobjectionable method of parallax, it was discovered that photometric measurements had placed some of the stars much nearer to the earth than their real

distances. Hence it was discovered that some of the stars are larger and more brilliant than our sun, whilst some of them are smaller.

At the close of this lecture Professor Grant spoke of the space-penetrating power of the telescopes, and said that Lord Rosse's 40-ft. reflector will define a star so far off that its light takes 8,064 years to reach the earth, travelling at a speed of about 190,000 miles per second.

April 29th, 1869.—Professor Tyndall began this lecture on "Light" by stating the relative values of the emission theory of light and the undulatory or wave theory. He said that Newton supposed light to consist of small particles shot out with inconceivable rapidity by luminous bodies, and fine enough to pass through the pores of transparent media. Crossing the humours of the eye, and striking the optic nerve behind the eye, these particles were supposed to excite vision. Considering the enormous velocity of light, the particles, if they exist, must be inconceivably small; for if of any conceivable weight, they would infallibly destroy so delicate an organ as the eye. A bit of ordinary matter one grain in weight, and moving with the velocity of light, would possess the momentum of a cannon-ball 150lb. weight moving with a velocity of 1,000ft. a second. Millions of these light particles, supposing them to exist, concentrated by lenses and mirrors, have been shot against a balance suspended by a single spider's thread; this thread, though twisted 18,000 times, showed no tendency to untwist itself; it was therefore devoid of torsion But no motion due to the impact of the particles was even in this case observed The lecturer referred to many other highly important points.

May 1st, 1869.—The annual meeting of the Institution was held on Saturday, May 1st, Sir Henry Holland, Bart., President, in the chair. The annual report of the committee of visitors for the year 1868 was read and adopted. It showed that the books and pamphlets presented in 1868 amounted to 116 volumes, making, with those purchased by the managers, a total of 220 volumes added to the library in the year, exclusive of periodicals. Fifty new members were elected in 1867. Sixty lectures and twenty evening discourses were delivered during the year 1868.

May 4th, 1869.—Professor Grant, F.R.S., devoted a large portion of this, his fifth lecture upon "Stellar Astronomy," to the consideration of the motions of double stars. With much care and labour it has been discovered that the smallest of two such stars revolves round the larger, or, more strictly speaking, the two revolve around their common centre of gravity. The law of gravitation which holds good in our solar system also, therefore, governs the motions of many of the stars, and doubtless exerts its sway over the whole of the visible universe. There are hundreds of double stars, and the orbits of some few of these have been carefully measured.

May 6th, 1869.—Dr. John Tyndall, F.R.S., gave his fifth lecture upon "Light."

May 7th, 1869.—Captain Moncreiff gave a lecture upon "the Moncreiff System of Working Artillery" to a large audience. His system of working heavy guns, whereby the force of the recoil is utilised to lower and raise the gun on the see-saw principle, the gun being at one end of a bent lever and a weight at the other, has already been described in these columns. The plan does away for the necessity of embrasures in fortifications, because the gun is loaded below the level of the parapet, and then rises above it by means of the counterbalancing weight.

May 8th, 1869.—Professor Seeley, in the first of three lectures on "Roman History," entered into the question whether or no Cæsar was a great reformer, and he described the constitution of the Roman Empire at this period of its history.

May 11th, 1869.—Professor R. Grant, F.R.S., in his sixth lecture upon "Stellar Astronomy," gave special attention to the distances of the fixed stars.

## THE LONDON ASSOCIATION OF FOREMEN ENGINEERS.

A crowded meeting of members and friends of this rapidly growing institution took place on Saturday the 5th of May, at the City Terminus Hotel. The chair was filled by the President, Mr. J. Newton, of the Royal Mint, and the vice-chair by Mr. John Ives. The election of new associates preceded the immediate business. Mr. Fergus Jordan, Mr. Samuel Goddard, Mr. John Hooden, and Mr. Welch, constituted the ordinary members; and Mr. N. H. Allan and Mr. Whieldon were the honorary associates elected.

Mr. David Walker then read a paper on the "Simplification of the Patent Laws." After defining what patent rights really mean, the author traced at considerable length and with great lucidity the history of the patent system from the time of Queen Elizabeth to the present hour. He combated the views of Mr. Macfie, Sir Roundell Palmer, Lord Stanley, and others, who took part in a recent debate on the abolition of the patent laws in the House of Commons, and declared himself in favour of a sweeping amendment of the patent system, but quite opposed to abolition. He considered the principal evils of the present law of patents to consist in—(1) the exorbitant cost of a patent; (2) the imperfect security it afforded to an inventor; (3) the litigation which its maintenance entailed; and (4) the cumbersome and vexatious nature of the legal machinery for settling disputed questions affecting patent rights. The first demand he would make was, that the original cost of a patent should be reduced to a sum not exceeding what was absolutely necessary to cover legitimate expenses. In the next place there should be appointed a competent body of skilled men, whose characters were above reproach, and who should be empowered to judge of the merits or defects of an invention, and decide as to whether it was a proper subject for a patent or otherwise. He would also recommend that a special tribunal should be established for deciding disputed questions of patent right. Common juries, as a rule, were quite inadequate to this task. Finally, he would ask that, as the rights of authors and inventors were absolutely analogous, so the laws relating to invention should be assimilated as closely as possible to those of copyright. These points, the reader of the paper maintained, were of vital importance, and when they were gained the simplification of the British patent law would be an accomplished fact. This constitutes the barest summary of Mr. Walker's contribution. It was followed by a discussion by Messrs. Humes, Thorburn, Irvine, Bragg, Muir, Shotton, Ives, Vinicombe, and others, the feeling expressed by all being favourable to the reformation rather than the destruction of the patent system. In fact, it was manifest that the meeting was unanimously of this way of thinking. In putting the usual vote of thanks to the author of the paper, Mr. Newton took occasion to say that he hoped another Royal Commission would ere long be nominated to examine into the whole subject of patents at home and abroad. By comparing the various systems at work throughout Europe—and notably in the United States of America—with that in force in this country, data might be obtained which would be of service to the Legislature in amending our own admittedly defective patent laws. For himself, he was exceedingly glad that the question had been ventilated at a meeting such as theirs, because every member was a practical man, and most of them had had actual experience of the evils they deprecated. Certainly opinions thus formed were worthy of consideration, and they had been expressed in a manner which showed that the interests of all classes of the mechanical trades, and not one in particular, were recognised by the Associated Foremen Engineers.

[Mr. E. J. Reed, C.B., Chief Constructor of the Navy, writes to a contemporary, stating that in the report of the discussion which followed the reading of Mr. Rae's paper on "Iron Shipbuilding," he was made to say that he "not only disapproved of certain patents, but condemned all patents." Mr. Reed states that he must have been misunderstood. What he intended to say was that, in his opinion, every shipbuilder ought to be perfectly free to connect the keel and keelson of a ship with the stem and sternpost if he sees fit; and that the attempt to deprive him of this liberty, except upon the condition of paying a royalty to a patentee, appeared to him preposterous. He also added that, if patent claims were pushed to such extreme lengths as this, all patents, and the patent system itself, would be laid open to objection. Beyond this it was not his intention to go, as he had not yet weighed the advantages and disadvantages of the patent system with sufficient care to form a final judgment either way.]

## MONTHLY NOTES.

Engineers for India.—The following letter has been privately circulated by its author amongst the profession, since its original publication:—

As the recorded opinion of a well-educated engineer, himself of much more than average natural ability and practical resource, it is worthy of attention. The notion of practice forming part of the curriculum for engineering, however, is far less new even in the United Kingdom than it would appear to be to Mr. Stoney. To go no further than his own university, that of Dublin, Sir John M'Neil, C.E., for several years conducted the practical examination of the school of engineering, which has since devolved on Professor Downing, himself a practical engineer. In other countries, France for example, the *Cour d'Études* of the *École des Ponts et Chaussées*, provides for examination in practice at the later period of the course.

There are great difficulties in making any really practical examination practicable, as no one ought to know better than Mr. Stoney; and for ourselves we are by no means convinced of their extreme importance. "Cram" can be got up for that as well as for theory.

In any case, what is first needed is the incorporation of the engineering profession in some way, so as to give unity and authority to this or any other educational plan.

TO THE EDITOR OF THE ENGINEER.

Sir,—Your recent leader on Indian Engineering induces me to make a few remarks on the present system of competitive examinations for professional appointments. A liberal education and scientific training are now generally considered as necessary a preparation for the engineering profession as the same or literary acquirements are deemed requisite for other learned professions; and the present competitive system is, perhaps, the best that can be devised for testing purely theoretic attainments; but the great defect of Government examinations is that they do not sufficiently test practical knowledge. To insure this, I would recommend that the young candidates be examined—first, in the general subjects which are embraced in a liberal education, and in those branches of science which are required by the engineer; and having passed a satisfactory examination in these, I would then require the candidates to spend one or two years in practical instruction on actual works, and during this period their proficiency should be tested by half-yearly examinations in practical matters relating to construction, these examinations being confined to practice and not going again into abstract theory. Thus, the first examination would test the efficiency of the candidates in those branches of general education which all gentlemen are supposed to acquire, as well as their range of scientific attainments. This preliminary examination being passed, the student would not be required to maintain so familiar an acquaintance with mathematics and physical science as a merely scientific examination requires, but could devote himself thoroughly to mastering the practical details of his profession. Thus, on the one hand, we should have well-educated scientific men in place of the half-educated men that are but too frequently turned out as three or four-year pupils of engineers, and, on the other hand, we should avoid giving appointments requiring practical knowledge to the equally useless men of mere book-learning, such as are many of those trained in the schools of engineering attached to our colleges, until they have spent a year or two in practice. Another advantage would result from having strict practical examinations, namely, that the men who are now crammed up or merely qualified in small engineers' offices, where no works of importance are either designed or carried out, and whose certificates of a year's pupilage are, therefore, no guarantee whatever of real practical knowledge; these men would not pass out to India to learn there, if ever they do learn, the practical knowledge which they are already supposed to have acquired at home.

To carry out a scheme such as I propose, it would be necessary that the Government give some small salary, say £50 each half-year, to men who, having passed the first examination successfully, are studying the practical part of their profession, such terms being annexed to this as experience in similar cases may dictate; but I believe pretty frequent examinations in practical knowledge should form an essential part of the programme. This project requires, of course, two classes of examiners—1, professorial, such as the Universities supply; 2, professional examiners, namely,

engineers in actual practice and engaged in the execution of works of considerable importance; and the practical examination should embrace so extensive a range of subjects that it would be adapted for men trained in one or other of the many departments into which civil engineering is subdivided, namely, harbour, railway, hydraulic, sanitary engineering, irrigation, &c., suitable answering in one or other of which subjects would qualify the candidate for his final appointment, the limit of age for which might be advantageously extended to twenty-five years.

The foregoing remarks apply to county and local surveyorships, as well as to Indian appointments, and, *mutatis mutandis*, might, I believe, be advantageously applied to the medical service and the Royal Engineers, and, in general, to all Government professional appointments where a high standard of education and practical skill are required.

42 Wellington Road, Dublin, March 29, 1869. BINDON B. STONEY.

NATIONAL EDUCATION LEAGUE.—The following circular has reached us. Coinciding, as we do fully, in the indispensable necessity of primary education in Great Britain as the only basis for better technical education, and, what is more important, for moral elevation, we wish all success to the National Education League; but we greatly doubt that its machinery will prove adequate to do more than keep alive public attention to what, if dealt with at all and to any good end, must so be by comprehensive and courageously adopted imperial measures, regardless of sectarian prejudices.—ED.

Sir,—I am requested by the provisional committee, formed for the promotion of a National Education League, to forward to you the annexed draft of a scheme which they have drawn up for the furtherance of a system of education which shall reach all those children who are now growing up in a degree of ignorance injurious, alike to their own interest and to that of the community at large.

The provisional committee are of opinion that in those parts of the country where a sufficient school organisation does not exist, the deficiency can be speedily and adequately supplied only by the combined action of the central and local authorities. The new machinery to be provided by this joint action need not injuriously interfere with those existing schools which are satisfactorily educating the people, but the provisional committee are of opinion, that it is all-important that no time should be lost in bringing a good education within the reach of even the poorest and the most neglected children in the country; and they are also of opinion, that when the means of education shall everywhere exist, the poverty or apathy of parents ought not to be allowed to prevent those means being availed of by their children.

If you are willing to assist in carrying out the objects of the proposed League, I shall feel obliged by your signing and returning to me the enclosed form.

I am, your obedient servant,

Birmingham, April 29, 1869. GEORGE DIXON.

*Object.*

The establishment of a system which shall secure the education of every child in England and Wales.

*Means.*

1. Local authorities shall be compelled by law to see that sufficient school accommodation is provided for every child in their district.
2. The cost of founding and maintaining such schools as may be required shall be provided out of local rates, supplemented by Government grants.
3. All schools aided by local rates shall be under the management of local authorities and subject to Government inspection.
4. All schools aided by local rates shall be unsectarian.
5. To all schools aided by local rates admission shall be free.
6. School accommodation being provided, the State or the local authorities shall have power to compel the attendance of children of suitable age not otherwise receiving education.

The payment of an annual subscription shall constitute membership.

The executive body shall be a council elected at a general meeting of the members, convened for that purpose.

The council shall appoint a chairman, an honorary secretary, a treasurer, and such paid officers as may be required.

The general business of the League shall be conducted by the council, and they shall make all arrangements for the formation of branch societies, collect and disseminate information, and prepare the way for such legislation as will carry out the objects of the League.

HER MAJESTY'S SHIP "INVINCIBLE."—The introduction of the turret system of armament has greatly impressed naval men and others with the advantages to be derived from an all-round fire in ships of war. In a monitor this can be obtained without difficulty, owing to the unobstructed deck, and the absence of masts and rigging; but in nearly all the sea-going turret-ships which have been proposed, the fire is more or less impeded by forecastles, poops, or deckhouses, and by many of the numerous fittings necessitated by the use of sails. When, therefore, the Admiralty called upon the Chief Constructor of the Navy to produce a heavily-armed cruising ship of moderate dimensions, capable of proceeding to any part of the world, not requiring a very large crew, and having a speed of at least 13 knots, he preferred to adopt the broadside system, feeling sure that he could obtain on it a near approach to that all-round fire which was so necessary to enable them to compete upon equal terms with the monitors of the United States and other nations. As the result shows, Mr. Reed has been very successful in his endeavours, and has obtained in these vessels the nearest approximation to an all-round fire as yet possessed by any ship of war. He has attained his object by making a portion of the upper deck amidships project over the side similar to a sponson. The battery thus formed he protects with armour plating, within which are placed four guns, one at each corner, worked at ports cut in the enclosing bulkheads, and capable of training from a line parallel to the keel to another at right angles to this, or through an arc of 90 degrees, the topsides before and abaft the bulkheads being slightly recessed in order to admit of direct ahead fire. The fire of these four guns is crossed by that of the guns in the main deck battery, and every point on the horizon is thus commanded by guns behind armour. The vessels to which this form of battery has been applied are known as the *Invincible* class, and are four in number, viz., the *Audacious*, *Iron Duke*, *Vanguard*, and *Invincible*. The first was launched from Messrs. Napier's yard at Glasgow last February, the second and third are in course of construction at Pembroke and Birkenhead respectively, while the *Invincible* has recently been launched by Messrs. Napier. The principal dimensions of these vessels are—Length, 280 feet; breadth, 54 feet; mean draught, 22 feet; burthen, 3,774 tons. They carry fourteen guns, consisting of six 12½-ton guns on the main deck, and four of the same calibre on the upper deck, as well as four 64-pounders, these last being used as bow and stern chasers. They have the ordinary belt and central battery, but the latter includes both the main and upper decks, instead of the main-deck only, as is generally the case. The armour on the sides of the battery is 6 inches thick, that on the bulkheads 5 inches thick near the ports, and 4 inches elsewhere. The belt extends from the main-deck to 5 feet below the water-line, the strake at the water-line being 8 inches, and the remainder 6 inches in thickness. The backing consists of 10 inches of teak upon a double thickness of ⅝-plate, which forms the skin of the ship. The frames are of the ordinary bracket description, in combination with longitudinals, and a double bottom, as in the *Bellerophon* and *Hercules*; but the *Invincible* class differs from these ships in having no side or wing-passage bulkheads, as they are termed. In place of them, however, the frames under the armour are made very much deeper than usual, so that if the ram of an opponent should penetrate the outer bottom, the inner one would still be intact. The cellular system of construction introduced by Mr. Reed into the ships of the Royal Navy prevents any great influx of water in such a case.

Of course, to such a vessel as the *Invincible*, it is a great advantage to possess good powers of manœuvring, and these are obtained by giving the ships of her class balanced rudders and twin-screws. The latter are driven by independent engines of 800 collective horse-power, working up to six or seven times that amount; they are upon the improved expansive plan, with surface condensers, superheaters, and are being constructed by Messrs. Napier. The estimated cost of ship and engines is £221,757, which includes masts and yards, &c., and fitting the ship for sea, but not the providing of armament, rigging, or stores. The *Invincible* class has been exposed to much unfavourable criticism, but it should not be forgotten that they are what may be termed second-rate ironclads, and as such it would be absurd to expect from them all those offensive and defensive powers that distinguish the *Hercules* or *König Wilhelm*. That they form a useful class may be inferred from the fact that the French, who have ever been distinguished for the scientific skill with which they design their ships of war, have seven very similar vessels in course of construction for their navy. It has been said respecting this class that the speed is low, and the quantity of fuel carried insufficient; but the fact is that the speed is really a high one, and is only exceeded by that of much larger first-class iron-clads; while the supply of coal is, in proportion to the rate of consumption, as large as, or larger than, that of most of our ironclads. Although the plan of giving two tiers of guns to armour-plated ships has been advocated by Mr. Scott Russell and other authorities, these are the first vessels in the English navy in which it has been adopted. It has one great advantage, and that is, that the fire of the guns can be concentrated on an object much more effectually than when they are in a single line. Of course, building a bulkhead across the upper deck interferes somewhat with the working of the ship; but if this inconvenience can be tolerated in the *Invincible*, there is no reason why it should not be in larger vessels; and in the *Sultan*, a sister ship to the *Hercules*, a similar plan has been adopted. Moreover, a second tier of guns necessitates but a comparatively slight increase of armour, and this is added to the midship part of the ship, where she is best able to carry it. These upper-deck guns also, being so high out of water, can be fought when the main-deck ports of other ships would have to be closed: this is a very great advantage in a sea-going ship.

THE RIVAL RIFLES.—The current number of the *Proceedings of the Royal Artillery Institution* contains an interesting account of a trial lately made at Woolwich of the Chassepot rifle in comparison with the Henry-Martini. As regards accuracy, it appears that the Chassepot was greatly inferior to the English arm. The worst target made with the Henry-Martini at 500 yards was 1·62 feet, the best with the Chassepot was 2·38 feet. The best target with the Henry-Martini showed a still higher degree of accuracy,—viz. 0·96 feet. The trajectory of the Henry-Martini was flatter than that of the Chassepot—viz. 8 feet 2 inches against 10 feet. In simplicity of manipulation the English rifle was superior, and it is far less fatiguing to use. In firing for rapidity the Chassepot gave 20 rounds in 1 min. 42 sec., the Henry-Martini 20 rounds in 48 sec., or more than twice the rapidity. The Chassepot ammunition is lighter than that of the Henry-Martini rifle, in consequence mainly of the bullet of the former weighing 380 grains only against 480 grains. The lightness of the Chassepot ammunition appears to be the only point in its favour; and against this may be set the following advantages on the side of the English rifle:—Increased strength and safety of ammunition, greater accuracy, longer range, flatter trajectory, higher penetrative power, greater safety, strength, and simplicity of construction, increased rapidity of fire.

THE SUEZ CANAL.—The arrangements for the opening of the Suez Canal in November are fully developed. The Viceroy of Egypt proposes to entertain his guests with unprecedented magnificence. On the banks of the canal are to be erected lodges, constructed, fitted, and decorated so as to be reproductive of the characteristics of the several countries to which the guests belong. Public amusements, theatres, circuses, balls, and fêtes are to be provided for the recreation of the assemblage, which promises to be as brilliant as varied in its character. It is confidently expected that the Empress of the French will attend in person; if this be the case, the Emperor Francis Joseph of Austria will be present. The heir-presumptive of the Italian Crown will represent King Victor Emmanuel; the King of Prussia will send a member of the Royal family; and the Prince of Wales, possibly accompanied by Prince Arthur, will represent Queen Victoria. The event is, therefore, likely to be one of extraordinary grandeur, and will doubtless pass off with great *éclat*. Its international significance well warrants these manifestations of this world-wide interest.

APPLICATIONS FOR

# PROVISIONAL PROTECTION FOR INVENTIONS

## UNDER THE PATENT LAW AMENDMENT ACT.

☞ When the city or town is not mentioned, Loudon is to be understood.

*5th May* 1869.

1376 T. Sibley, Ashton-under-Lyne, Lancaster—Velocipedes
1377 D. Adamson, Newton Moor Iron Works, near Hyde, Chester—Portable and other steam-engines and boilers
1378 J. F. Kent, Thornton Heath, Surrey—Mortising, tenoning, and sawing machine
1379 G. Clark, Northumberland Street, Strand—Cartridges
1380 W. MacKean, Paisley, N.B.—Cattle food
1381 E. H. Richmond, King William Street—Apparatus and process for preserving fresh meat and other animal food
1382 A. Cocke, Water Lane—Ventilating railway and other carriages
1383 H. Highton, Brighton—Making, hardening, and preserving artificial stone
1384 C. Moore, Sketty, near Swansea—Screw propeller
1385 C. J. Galloway and J. H. Beckwith, Manchester—Slide-valves and valve gear to piston-valves for steam-engines
1386 J. E. Phillips, Grantham, Lincoln—Sewing-machines, and tables for the same
1387 R. H. Ray, Saffron Walden, Essex—Reaping and mowing machines
1388 T. Welton, Grafton Street, Fitzroy Square—Applying oxygenated and other gas-charged charcoal for curative and other purposes

*6th May* 1869.

1389 E. N. Hudson, Percy Terrace, Bayswater—Carriages, vehicles, or conveyances propelled or moved by the power of persons carried or conveyed thereby
1390 H. E. Newton, Chancery Lane—Enlarging and reducing basso-relievos, plans or drawings, and writings.—A com.
1391 C. D. Abel, Chancery Lane—Treatment of cast-iron for the production of wrought-iron and steel.—A com.
1392 J. Tolson, Dalton, near Huddersfield—Cleaning the cards of carding engines or machines having cylinders or rollers clothed with cards
1393 W. Bennett, Aston, near Birmingham, and J. Currall, Birmingham—Kitchen ranges
1394 I. and G. Battinson and T. Whitehead, Halifax—Machinery for combing wool
1395 W. Galloway, Craigie, Ayr, N.B.—Braking or retarding railway trains
1396 W. Galloway, Craigie, Ayr, N.B.—Communicating between passengers, enginemen, and guards in railway trains
1397 J. Needham, Chiswick—Velocipedes
1398 G. Kent, High Holborn—Refrigerator.—A com.
1399 J. M. Hart, Cheapside—Safes or depositories for security
1400 G. T. Bousfield, Brixton—Braces.—A com.

*7th May* 1869.

1401 E. Seyd, Princes Street—Fluid meters.—A com.
1402 R. Fennelly, Wellington Chambers—Washing-out casks.—A com.
1403 D. and A. Posener, Mansell Street, Goodman's Fields—Pipes for smoking tobacco
1404 G. N. Mansfield, Great Portland Street—Manufacture of parquet flooring
1405 J. Ramsbottom, Leeds, and T. M. Pearce, Bradford—Steam and hydraulic apparatus for pumping, forcing, and measuring water, and for raising weights
1406 A. J. Murray, Camberwell—Reaping and mowing machines
1407 F. Leonardt and H. Hewitt, Birmingham—Metallic pens, penholders, and metallic boxes for holding pens
1408 J. G. Tongue, Chancery Lane—Envelopes.—A com.

*8th May* 1869.

1409 F. C. Knowles, Lovell Hill, Berks, Baronet—Purifying and converting cast-iron into malleable iron or into steel
1410 W. Henderson, Glasgow, N.B.—Apparatus for finishing woven fabrics
1411 B. Hunt, Serle Street, Lincoln's Inn—Horse collars.—A com.
1412 H. Myers, Miles Platting, Manchester—Furnaces of locomotive and other boilers
1413 E. Maybury, G. Matthews, and E. Marston, Pendleton, Lancaster—Puddling furnaces
1414 R. and G. Cadbury, Birmingham, and J. M. Rendall, Torquay, Devon—Biscuit manufactured from the cocoa bean
1415 E. S. Copeman, Norwich—Communicating between the several parts of railway trains

*10th May* 1869.

1416 A. B. Hawes, India Office, Whitehall—Bottles and flasks
1417 W. N. Nicholson, Newark, Nottingham—Hay-making machines
1418 H. R. Lumley, Marlborough Place, St. John's Wood—Treatment of molten iron in order to free it from all impurities
1419 H. A. Dufrené, Paris—Dessicating and preserving meat.—A com.
1420 E. Field, Adelphi—Steam fire-engines and other pumping apparatus
1421 C. Lauth, Paris—Dyeing and printing
1422 R. Blezard, Liverpool—Dressing millstones
1423 W. Currie, Edinburgh—Manufacture of cushions, seats, mattresses, life-preservers, &c.
1424 M. S. Wolfgang, Stratford-le-Bow—Cricket and other balls
1425 R. F. Hoppe, Cheapside—Musical boxes, albums, &c.—A com.
1426 W. E. Newton, Chancery Lane—Hardening common or grey cast-iron, and converting articles of iron into steel.—A com.
1427 W. E. Newton, Chancery Lane—Gun-locks.—A com.
1428 W. B. Smith, Coventry—Watches, chronometers, and other timekeepers
1429 J. Withers, Handsworth, Stafford—Water meters
1430 W. R. Lake, Chancery Lane—Bronze ordnance.—A com.
1431 H. Bessemer, Cannon Street—Manufacture of malleable iron and steel
1432 H. Bessemer, Cannon Street—Construction and mode of working furnaces, and apparatus employed in fusing malleable or wrought iron and steel and pig or other carburets of iron, and obtaining cast-steel or homogeneous malleable iron therefrom
1433 H. Bessemer, Cannon Street—Conversion of fluid crude iron and molten pig or other carburets of iron into fluid homogeneous malleable iron and steel
1434 H. Bessemer, Cannon Street—Treatment of crude or pig-iron and other carburets of iron
1435 H. Bessemer, Cannon Street—Construction and mode of working blast furnaces employed for smelting the ores of iron, &c.

*11th May* 1869.

1436 J. Hall, Birmingham—Firearms
1437 E. Brennan, Manchester—Machines for polishing threads, braids, and woven fabrics
1438 C. Cross and A. Heywood, Manchester, and G. D. and T. B. Wilson, Cressbrook, Derby—Velocipedes
1439 T. Dunn, Pendleton, Lancaster—Velocipedes
1440 W. R. Lake, Chancery Lane—Detergent or saponaceous compound.—A com.
1441 C. D. Abel, Chancery Lane—Galvanic batteries.—A com.
1442 B. Latham, Westminster Chambers—Ventilators for sewers
1443 B. J. B. Mills, Southampton Buildings—Casting metals under pressure.—A com.
1444 J. A. Marden, Boston, U.S.—"Steam and other enginery."
1445 J. B. Payne, Chard, Somerset—Fittings for roller blinds
1446 L. Wray, Ramsgate, Kent—Crushing, grinding, and pulverizing quartz
1447 A. Vickers, Old Broad Street—Connecting and sustaining the rails of railways.—A com.
1448 A. Henry, Edinburgh—Breech-loading firearms

*12th May* 1869.

1449 C. H. Merritt, Brunswick Square—Apparatus for basting
1450 J. Robey, Newcastle-under-Lyme, Stafford—Sugar-refining
1451 E. T. Hughes, Chancery Lane—Tea and coffee urns.—A com.
1452 P. W. Flower, Briton Ferry, Neath, Glamorgan, and W. Flower, Great Winchester Street Buildings—Producing impressions upon tin and terne plates, &c.—A com.
1453 H. Ing, St. John Street Road—Fastenings and clasps for albums, books, &c.
1454 J. B. Handyside, Glasgow—Wheels
1455 T. Bullivant, Ledbury Road, Bayswater—Window sashes, shutters, and frames
1456 H. Robinson, Skipton, York—Kilns
1457 J. L. Greatorex, East Grinstead, Sussex—Urinals
1458 P. W. Flower, Neath, Glamorgan, H. Nash, Liverpool, and R. Heathfield, Birmingham—Coating sheets of metal with other metals
1459 J. H. Johnson, Lincoln's Inn Fields—Saw teeth.—A com.
1460 F. R. A. Glover, Brading, Isle of Wight—Anchors
1461 A. V. Newton, Chancery Lane—Expressing juices from organic matters.—A com.
1462 W. F. De la Rue, Bunhill Row—Obtaining a water-mark on paper

*13th May* 1869.

1463 V. de Stains, Shepperton Villas, N.—Wheels, treadles, and brakes
1464 E. V. Newton, Oxford Street, and P. M. Crane, Manchester—Composition for coating ships, boats, &c.
1465 J. Timmins and J. Gayton, Birmingham—Lever fastenings for securely holding in a state of tension cords, cables, &c.
1466 H. Luke, Manchester—Window sashes
1467 W. A. Lyttle, The Grove, Hammersmith—Electro-telegraphic apparatus
1468 T. G. F. Dolby, Forest Gate, Essex—Valve suitable for the admission of air to feeding-bottles
1469 J. Townsend and P. Forbes, Glasgow—Refining or treating oils and fats
1470 I. and G. Battinson and T. Whitehead, Halifax—Machinery for combing wool
1471 J. Fawcett, Huddersfield—Measuring oil, &c.
1472 C. Ferguson, Glasgow, N.B.—Washing, brushing, filling, and corking of bottles
1473 J. Bowmes, Mansfield, Nottingham—Steaming and compressing tobacco
1474 A. Friedmann, Hatton Garden—Ornament for personal wear
1475 W. Cadogan, Birkenhead—Couplings for connecting together the ends of driving straps or bands
1476 W. Stephenson, Scalcoats, York—Facilitating the consumption of smoke in furnaces

*14th May* 1869.

1477 I. and J. H. Story, Manchester, and H. Lea and T. Lane, Birmingham—Controlling the discharge of water from stand-pipes, drinking fountains, and ball-taps or valves
1478 J. and J. Kippax, Bolton-le-Moors, Lancaster—Weaving counterpanes
1479 C. W. Lancaster, New Bond Street—Apparatus for concentrating shot
1480 J. T. Griffin, Fleet Street—Knives and forks.—A com.
1481 W. Finley, Stockport—Brakes of railway carriages
1482 H. B. Barlow, Manchester—Cases for bottles and glass or other cups.—A com.
1483 G. F. Henry, 1, A. F. Bang, F. R. C. Monestier, and J. P. A. Figuier, Paris—Liquids for the lubrication of sheep's or other wool, &c.
1484 M. Wolfsky, Pilgrim Street—Sliding fastening or lock for purses, pocket-books, boxes, satchels, bags, &c.
1485 F. Hedley, Richmond, York—Horse shoes
1486 J. H. Johnson, Lincoln's Inn Fields—Treatment of beet-root and other pulps—A com.
1487 C. E. Spooner, Bron-y-Garth, Port Madoc, Carnarvon, and G. A. Huddart, Brynkir, Carnarvon—Railways
1488 G. T. Bousfield, Brixton—Apparatus for lifting building blocks of stone, concrete, &c.—A com.
1489 C. H. Gardner, West Harding Street, Fetter Lane, and J. Bickerton, Oldham, Lancaster—Lithographic and zincographic cylinder printing machines

*15th May* 1869.

1490 I. M. Milbank, Greenfield Hill, Connecticut, U.S.—Cartridges for breech-loading firearms
1491 V. R. Batchelor, Marylebone—Giving motion to wheels
1492 S. Corbett, Wellington, Salop—Velocipedes
1493 L. A. V. Dubourg, Leicester Street—Manufacture of gas
1494 F. E. Saxby and I. M. McGeorge, Liverpool—Conveying persons or things upon the common highway
1495 W. Wilkinson, Seymour Street, Euston Square, and M. Boss, Cleveland Street, Fitzroy Square—Embossing, printing, enamelling, and ornamenting glass, metal, wood, canvas, or other woven prepared fabrics or other substances, &c.
1496 J. S. Jarvis, Wood Street—A seamless collar and tie combined
1497 T. Berney, Bracon Hall, Norfolk—Mounting and working of defensive armour for the protection of ordnance

*17th May* 1869.

1498 F. Kohn, Robert Street, Adelphi—Extracting the juice from sugar-cane, beet-root, &c. A com.
1499 R. Bodmer, Holland Park, J. J. Bodmer, Newport, Monmouth, and L. R. Bodmer, Lansdowne Road, Notting Hill—Fire-grates
1500 R. Wilson, Patricroft, Lancaster—Machinery for preparing to be spun, and for spinning and doubling, cotton, &c.
1501 Henry de Garrs, Sheffield—Gas pendants and chandeliers
1502 H. G. Whitehead, Sheffield—Spring-knife cutlery
1503 R. Harlow, Heaton Norris, Lancaster—Hot-water boilers used for heating purposes
1504 D. Hitchin, Halifax—Looms
1505 A. Dunn and A. Liddell, White Street, Southwark—Metal cans or tins
1506 C. E. Brooman, Fleet Street—Applying brakes on railways.—A com.
1507 T. Wright and I. Fox, Nottingham—Manufacture of lace made on bobbin-net or twist-lace machines
1508 S. W. Clark, Tower Royal, and W. R. Sykes, Clapham—Hand-signal and other railway lamps
1509 W. E. Newton, Chancery Lane—Factory silver cans—A com.
1510 W. R. Lake, Southampton Buildings—Revolving firearms.—A com.
1511 W. R. Lake, Southampton Buildings—Drying sugar.—A com.
1512 W. R. Lake, Southampton Buildings—Forming the threads of metal screws.—A com.

*18th May* 1869.

1513 T. Norris, Frome, Somerset—Mowing and cutting grass
1514 A. Tatham, Ilkestone, Derby—Barbed needles
1515 T. and J. Fagg, Haymarket—Waterproof garments
1516 C. Moseley, Manchester—Construction of india-rubber bags for the manufacture of felt hats
1517 J. Norton, Sheffield—Ball and other cocks, taps, and valves
1518 J. Waterworth, Burnley, Lancaster—Fire-grates
1519 A. M. Clark, Chancery Lane—Tramway and other locomotive engines and carriages, and in the permanent way for the same.—A com.
1520 G. Allan, Leadenhall Street—Securing sheet metal and buckled or other metal plates employed for roofing, flooring, enclosures, &c.
1521 F. Walton, Wolverhampton—Coal-vases
1522 J. Woodward, Manchester—Gas and water meters
1523 W. Benson, Hexham, Northumberland—Treating or reducing ores
1524 J. L. Clark, Westminster, and J. Brotherton, Wolverhampton—Iron and steel tubes
1525 A. V. Newton, Chancery Lane—Paper-hangings.—A com.
1526 E. C. Warburton, Bristol—Registering secret votes
1527 F. Johnson and W. Hatchman, Little Love Lane—Umbrellas

1528 W. Green, Garforth, Leeds—Cleaning flower and garden pots
1529 W. Naylor, Mildmay Park—Railway brakes
1530 J. H. Johnson, Lincoln's Inn Fields—Firearms and apparatus for filling the same.—A com.
1531 E. Taylor, Blackburn—Washing, wringing, mangling, churning, and agitating liquids
1532 H. Livesey and T. Collison, Blackburn—Velocipedes
1533 J. Sawyer and J. Woodman, Islington—Propulsion of velocipedes
1534 R. E. Keen, Red Lion Court, Fleet Street—Securing panes of glass
1535 A. Van Winkle, Southampton Street, Bloomsbury—Securing corks in bottles.—A com.
1536 W. R. Lake, Southampton Buildings—Manufacturing capsules.—A com.

*19th May* 1869.

1537 E. H. and A. J. Solly, J. F. Hall, and R. B. Millman, Congleton, Chester—Spinning or twisting two or more ends of yarn and simultaneously twisting the same into one thread
1538 W. Martin, Manchester—Perambulators
1539 W. R. Lake, Southampton Buildings—Obtaining gelatine and other produets from animal substances.—A com.
1540 G. Martin, Dursley, Gloucester—Generating gases and chemical vapours employed in the manufacture of extract wool, and destroying the vegetable material in mixed fabrics
1541 P. McGregor, Manchester—Spinning and doubling
1542 J. T. Lucas, Brecknock Road, Camden Road—Velocipedes
1543 J. E. and A. Dowson, Westminster—Foundations for piers, bridges, &c.
1544 A. W. Banks, Newgate Street—Velocipedes
1545 W. Mitchell, Waterfoot, Lancaster—Manufacture of felted cloth
1546 D. Roberge, New York, U.S.—Shoes for horses
1547 G. V. Fosbery, V.C., Cowley, Middlesex—Breech-loading firearms and cartridges for the same
1548 F. Zysel and O. Burdett, Birmingham—Velocipedes
1549 W. McAdam, Glasgow, N.B.—Manufacture of pottery
1550 W. M. Moore, Balscaddin, Howth, Dublin—Caps or covers for the tops of bottles, &e.
1551 J. Langham, Leicester—Ash-pans for fire-grates
1552 W. F. Fuller, Worthing, Sussex—Securing or fastening the doors of safes and strong-rooms
1553 J. Bowman, York—Fittings for window-blinds
1554 A. J. Dudgeon, Millwall—Propelling vessels by means of water
1555 A. L. McGavin, Barge Yard, Bucklersbury—Propelling and manœuvring vessels.—A com.
1556 A. L. McGavin, Barge Yard, Bucklersbury—Constructing and propelling ships and other vessels.—A com.

*20th May* 1869.

1557 Z. E. Coffin, Newton Center, Massachusetts, U.S.—Stop-cocks or valves
1558 C. C. Parker, Brooklyn, New York, U.S.—Cord tighteners for curtain fixtures
1559 G. Perkyn, Derby—Cup-and-ball castor
1560 A. A. Rossignol, Paris—Electric clocks
1561 J. Reid, Glasgow, N.B.—Communicating between passengers and persons in charge of railway trains
1562 J. McMillan, Dumbarton, N.B., and J. McGregor, Glasgow, N.B.—Preservation of iron and steel
1563 M. Jarvis, Mansell Street, Goodman's Fields, and E. Millward, Skinner Street, Somers Town—Lock spindles and door knobs
1564 T. Herbert and J. Calvert Fowler, Riverhall Street—Conducting electricity for communicating or transmitting signals and alarms
1565 H. E. Newton, Chancery Lane—Portable coffee-mill.—A com.
1566 J. P. Nolan, Royal Artillery Barracks, Shoeburyness—Apparatus for measuring distances
1567 W. R. Lake, Southampton Buildings—Boat-detaching apparatus.—A com.
1568 G. Johnston, San Francisco, California, U.S.—Distillation of spirituous liquors

*21st May* 1869.

1569 J. G. Tongue, Southampton Buildings—Machinery for cutting wood, &e.—A com.
1570 S. Jackson, Bradford, York—Window-shutters
1571 E. H. Pulbrook, Tooting, Surrey—Organs
1572 W. H. Dupré, Jersey—Apparatus for giving light and ventilation
1573 A. Munro, Arbroath, N.B., and W. B. Adamson, Glasgow, N.B.—Treating certain metallic substances and certain metallic articles
1574 J. Platt, Birmingham—Manufacture of brooms and brushes
1575 C. W. Siemens, Great George Street—Calcining and smelting ores
1576 A. M. Clark, Chancery Lane—Apparatus for facilitating the opening of eggs.—A com.
1577 W. R. Lake, Southampton Buildings—Shearing, punching, bending, and otherwise working metal and metallic articles.—A com.
1578 C. J. Foster, Maldon, Essex—Reaping, mowing, and other similar agricultural machines
1579 N. Lawrence, Great Prescott Street—Lighting cigars
1580 J. Hudson and C. Catlow, Burnley, Lancaster—Looms
1581 W. Morris, South Hackney—Connecting and securing together the rails of railways

*22nd May* 1869.

1582 H. R. Lumley, Marlborough Place—Treating and purifying crude iron and making steel
1583 R. Orley, Axminster—Invalid bedsteads
1584 J. Lockwood, Leeds—Couplings for railway engines, carriages, and wagons
1585 E. T. Hughes, Chancery Lane—Horse-shoe nails.—A com.
1586 G. T. Bousfield, Brixton—Machinery for casting iron.—A com.
1587 J. H. Davis, Cape Town—Ships' compasses
1588 M. Tildesley, Willenhall, Stafford—Manufacture of sash pulleys
1589 S. Thomas, Redditch—Envelopes or wrappers for needles
1590 W. H. Bliss, Bayswater—Velocipedes
1591 L. J. Crossley and R. Hanson, Halifax, York—Steaming yarns

*24th May* 1869.

1592 W. Furness, New Street, Borough—Fastening for uniting the ends or other parts o driving belts or bands
1593 W. Mitchell, Manchester—Grinding metallic articles
1594 B. F. Weatherdon, Chancery Lane—Reacting turbine-wheel.—A com.
1595 W. A. Gilbee, South Street, Finsbury—Ice-houses, store-rooms, and refrigerators.—A com.
1596 M. H. de Goësbriand, Paris—Steam motors
1597 E. T. Hughes, Chancery Lane—Apparatus for the manufacture of brushes.—A com.
1598 G. Salt, Saltaire, York, and W. Inglis, Bolton, Lancaster—Steam-engine governors and admission or throttle valves
1599 A. Barclay, Kilmarnock, N.B.—Apparatus for injecting and ejecting liquids or fluids, &c.
1600 J. Brittain, Bowling Green Lane, Clerkenwell—Telegraphic instruments

*25th May* 1869.

1601 R. Richardson, Great George Street—Velocipedes
1602 J. Dick, Coatbridge, Lanark, N.B.—Rolls for rolling-mills
1603 J. H. Johnson, Lincoln's Inn Fields—Producing imitations of and substitutes for wood, ivory, stone, and other hard substances, applicable to the manufacture of billiard balls, &c.—A com.
1604 J. Trotman, Painswick, Gloucester—Fastenings for uniting the ends of machine driving bands or straps
1605 W. Jones and T. Sheffield, Manchester—Mathematical instruments
1606 F. T. Blake, Boulogne, France—Obtaining motive power
1607 G. H. Hoare, Southampton Row—Velocipedes
1608 A. McNeile and J. Slater, John Street, Pentonville—Carriage wheels
1609 L. Roman, Paris, France—Obtaining and applying hydraulic motive power
1610 R. Wheble, Cockspur Street—Hats
1611 R. Schomburg, Fleet Street—An apparatus for receiving and discharging cigar and tobacco ashes in railway and other carriages

*26th May* 1869.

1612 M. Benson, Southampton Buildings—Tools for cutting glass, &c.—A com.
1613 Major W. Palliser, Army and Navy Club—Vents and screw-nuts or collars for ordnance
1614 H. D. McMaster and A. Dale, Gilford, Ireland—Governor or regulator for steam-engines
1615 T. Vaughan and E. Watteeu, Middlesborough-on-Tees, York—Machine for nutting screw-bolts
1616 W. Tatham, Rochdale—Carding engines
1617 C. E. Brooman, Fleet Street—Bleaching vegetable fibres, threads, and fabrics.—A com.
1618 J. D. Brunton, Leighton Crescent, Kentish Town—Machinery for tunnelling, shaft sinking, and stone dressing
1619 C. F. Chew, George Street, Chalk Farm Road—Pianofortes
1620 J. J. Field, Highgate—Applying polarized light in connection with the microscope
1621 C. Hanson and J. Bottomley, Huddersfield—Obtaining motive power
1622 J. Cranston, Birmingham—Glass-houses for horticultural purposes
1623 J. Bridges, Ludgate Hill—Lever lock or fastening
1624 G. H. Ellis, Gracechurch Street—Apparatus for cleaning boots and shoes
1625 R. P. Williams, Great George Street—Fishes for fishing railway rails
1626 F. H. Lloyd, Wednesbury, Stafford—Manufaeture of steel and iron tubes and gun barrels
1627 E. G. Bartholomew, Upper Holloway—Electrical apparatus

*27th May* 1869.

1628 L., W., and J. Beesley, Dalton-in-Furness, Lancaster—Boilers
1629 J. Snape, Mountain Ash, near Aberdare—Pumps
1630 A. Edlmann, Palmerston Buildings, Bishopsgate Street—Apparatus for the manufacture of peat for charcoal, peat, fuel, and fire lights
1631 F. S. Angel, Hatton Garden—Tablets for advertising and other purposes.—A com.
1632 F. A. Barrow, Glasgow, N.B.—Purifying or bleaching mineral oils
1633 D. Foster, Sheffield—Hollow shot or shell
1634 P. Whiteside, Liverpool—Mowing and reaping machines.—A com.
1635 H. M. Ward, Ballymaconaghy, Knockbreda, Ireland—Spinning or twisting flax, &c.

*28th May* 1869.

1636 T. Bradford, Manchester—Drying closets and drying "horses"
1637 C. Plumb, Commercial Road, Lambeth—Ratchet brace, combining boring, tapping, screwing, and cutting-off apparatus
1638 H. A. Bonneville, Piccadilly—Box for enclosing portraits and photographic cartes.—A com.
1639 B. T. Newnham, Bath—Carriages
1640 J. Wilson, Royal Exchange Buildings—Wooden railways.—A com.
1641 J. Wilson, Royal Exchange Buildings—Manufacture of wrought-iron.—A com.
1642 J. Brönner and H. Gutzkow, Frankfort-on-the-Maine—Obtaining anthracen out of asphaltos
1643 S. and J. Prestwich, Farnworth, Lancaster—Velocipedes
1644 J. Ingham and I. Butterfield, Bradford—Apparatus for dressing warps
1645 G. J. Pedley, Harborne, and H. Grabowski, Willenhall, Stafford—Motive-power for driving velocipedes, sewing machines, &c.
1646 W. R. Lake, Sonthampton Buildings—Brushes for cleaning the tubes of steam boilers.—A com.
1647 W. R. Lake, Southampton Buildings—Machinery employed in the manufacture of bolts and nuts.—A com.
1648 G. F. Guy, Bury St. Edmonds, Suffolk—Sheathing for ships and vessels
1649 T. Clarke, Ladyfield, Wilmslow, Chester—Velocipedes for use on land or water
1650 B. Garner, Oldbury, Worcester—Bearings of axles for railway carriages and trucks
1651 F. Brown, Luton, Bedford—Velocipedes
1652 A. T. Fairgrieve, Sunderland—Composition adapted for coating the bottoms of wood and iron ships
1653 J. Fraser, Liverpool, and L. and R. Simon, Nottingham—Machine for cutting and scoring pasteboard, &c.

*29th May* 1869.

1654 J. L. Hancock, Sutton Coldfield, Warwick—Apparatus for making hay and harvesting corn and seeds
1655 J. L. Hancock, Sutton Coldfield, Warwick—Apparatus for clipping and trimming horses and other animals and for shearing sheep
1656 A. Hemingway, Manchester—Slide valves
1657 E. J. Hughes, Manchester—Preparation of cloth and yarn for printing and dyeing. A com.
1658 W. H. Turner, Blackburn—Lessening the discharge of smoke from furnaces
1659 J. Humphrey, Inches, Aberdeen, N.B.—Construction of iron keelsons, and the application thereof to wooden ships
1660 J. Sturgeon, Bolton-le-Moors, Lancaster—Apparatus employed in and conuected with the getting of coal and other minerals
1661 J. M. Muterse and H. G. de Valory, Guérande, France—Liquefiable compound substance to be used for extinguishing fires
1662 A. A. Saxe, Paris, France—Improved system of railway with helicoidal propulsion
1663 E. Davis, Great Mitchell Street—Velocipedes
1664 J. Smith, Loth, Belgium—Apparatus for holding the bobbins on the tubes or spindles of spinning and cap frames, also for regulating the drag of the thread passing on to the bobbins of common spinning frames
1665 J. F. Nicholls, Bristol—Converting any dining table into a billiard table
1666 J. J. R. Humes, Deptford, Kent—Brick moulds.—A com.

*31st May* 1869.

1667 J. Cockshoot and H. Weatherill, Manchester—Carriage axles and axle-boxes
1668 P. Kirk, Workington, Cumberland—Puddling furnaces
1669 H. T. Braithwaite, M.A., Cardington Street—Velocipedes, C.
1670 J. Hanworth and H. Horsfall, Todmorden, Lancaster—Furnaces for steam boilers, &c.
1671 R. S. Bartlett, Redditch, Worcester—Needle-cases or needle-holders.—A com.
1672 B. Littler, Cannock, Stafford—Guard for circular saws
1673 J. Bullough, Accrington, and C. Catlow, Burnley, Lancaster—Looms
1674 C. E. Brooman, Fleet Street—Boilers and furnaces—A com.
1675 G. Preston and J. Prestige, Deptford, Kent—Lamps
1676 R. Mathers, Leeds—Supports and mattresses for beds, couches, ottomans, sofas, &e.
1677 J. Dockray, Leeds—Carding engines
1678 W. E. Newton, Chancery Lane—Locking corks or stoppers in bottles.—A com.
1679 D. Evans, South Hackney—Construction of ships, boilers, buoys, casks, &c.
1680 J. King, Norwich—Cinder-sifter
1681 S. Birch, Belfast—Handkerchief, glove, and other fancy boxes
1682 W. R. Lake, Southampton Buildings—Mechanism for propelling and guiding vehicles—A com.
1683 H. Holdrege, New York, U.S.—Making gas for illuminating, heating, and other purposes.—A com.
1864 J. H. Johnson, Lincoln's Inn Fields—Stoves for culinary purposes.—A com.

# STEAM GENERATOR.

B. C. CRAWFORD, NEWCASTLE UPON TYNE
Patentee.



Fig. 1.

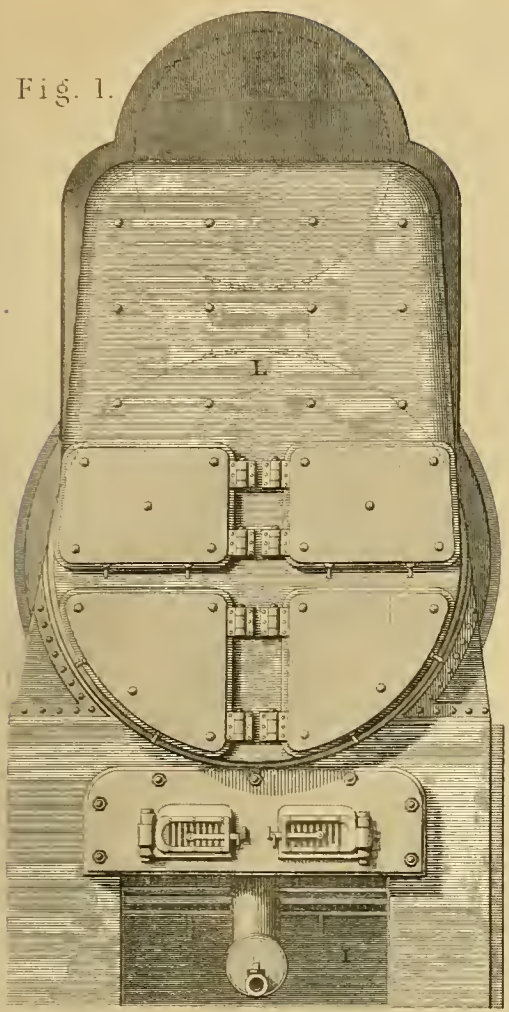



Fig. 2.

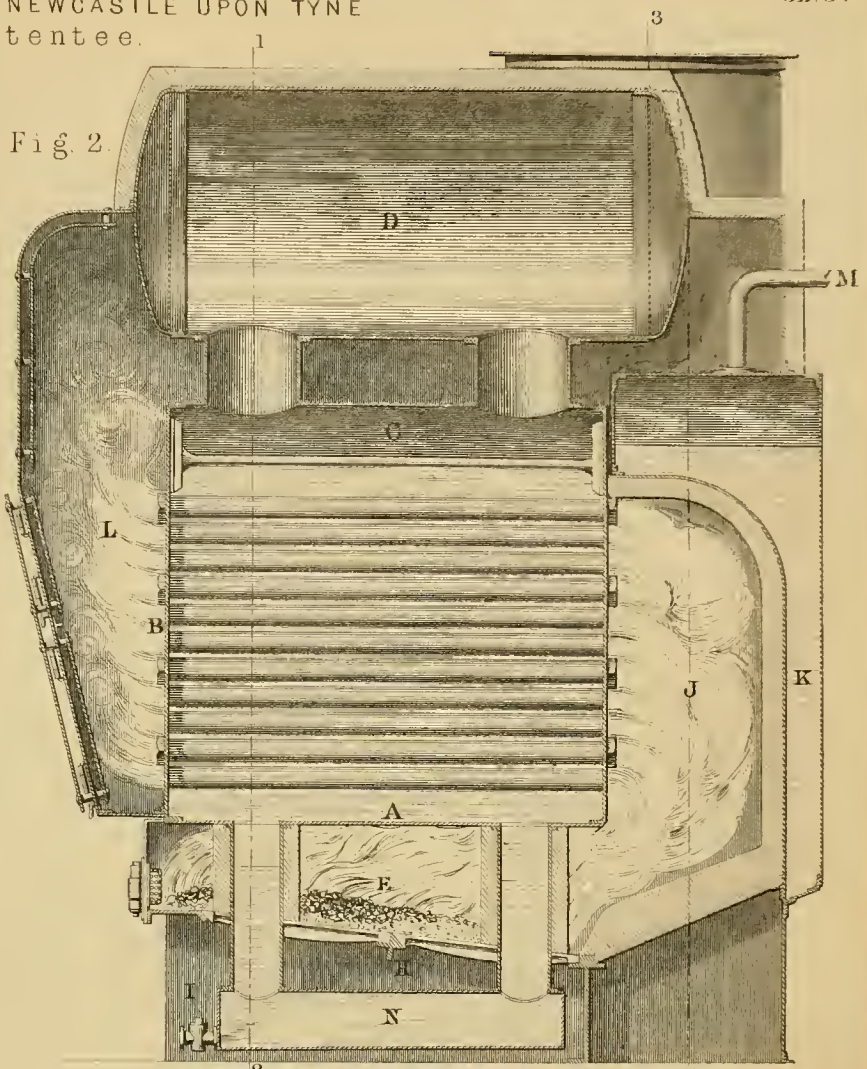



Fig. 3.

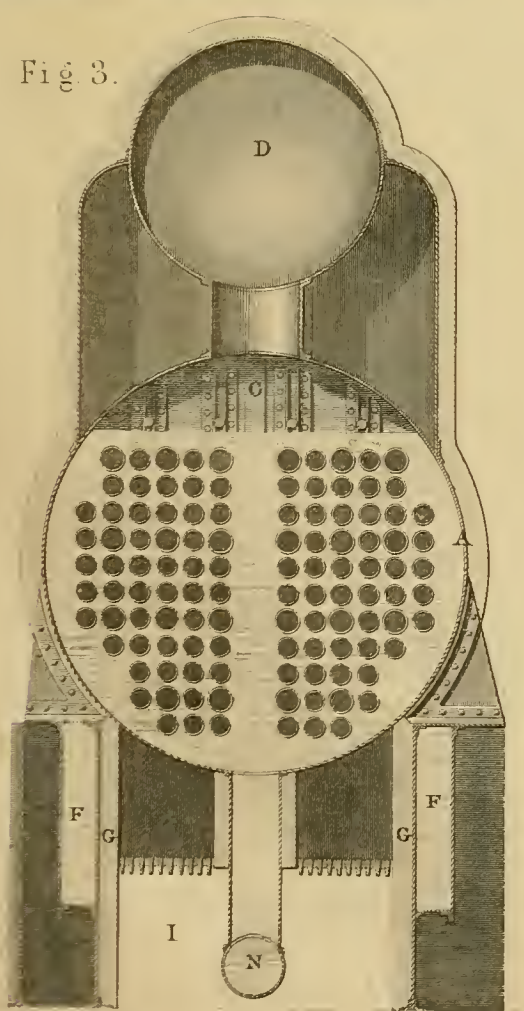
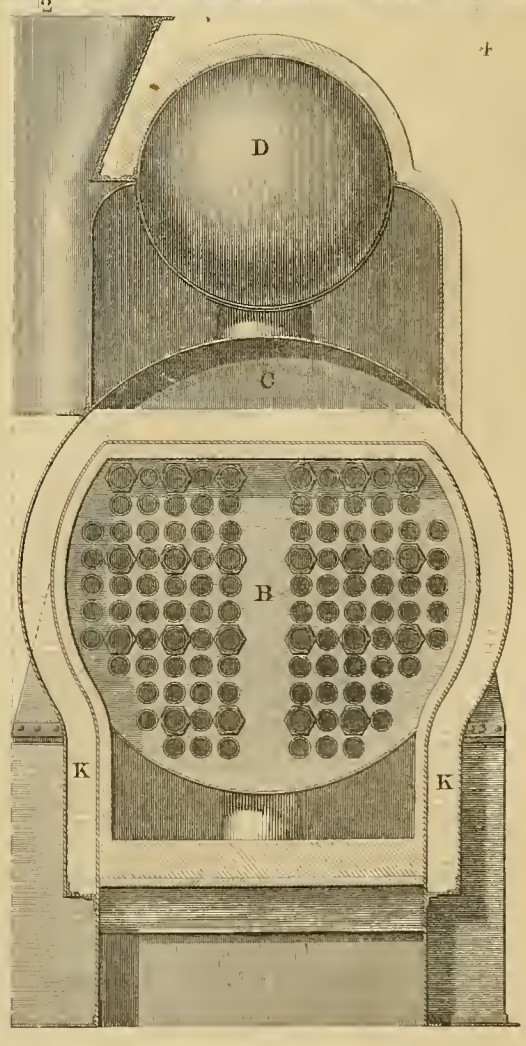



Fig. 4.



# GOVERNORS.

MESSRS W. J. AND C. A. KESSELMEYER & E. H. NACKE,
Patentees.



Fig. 1.

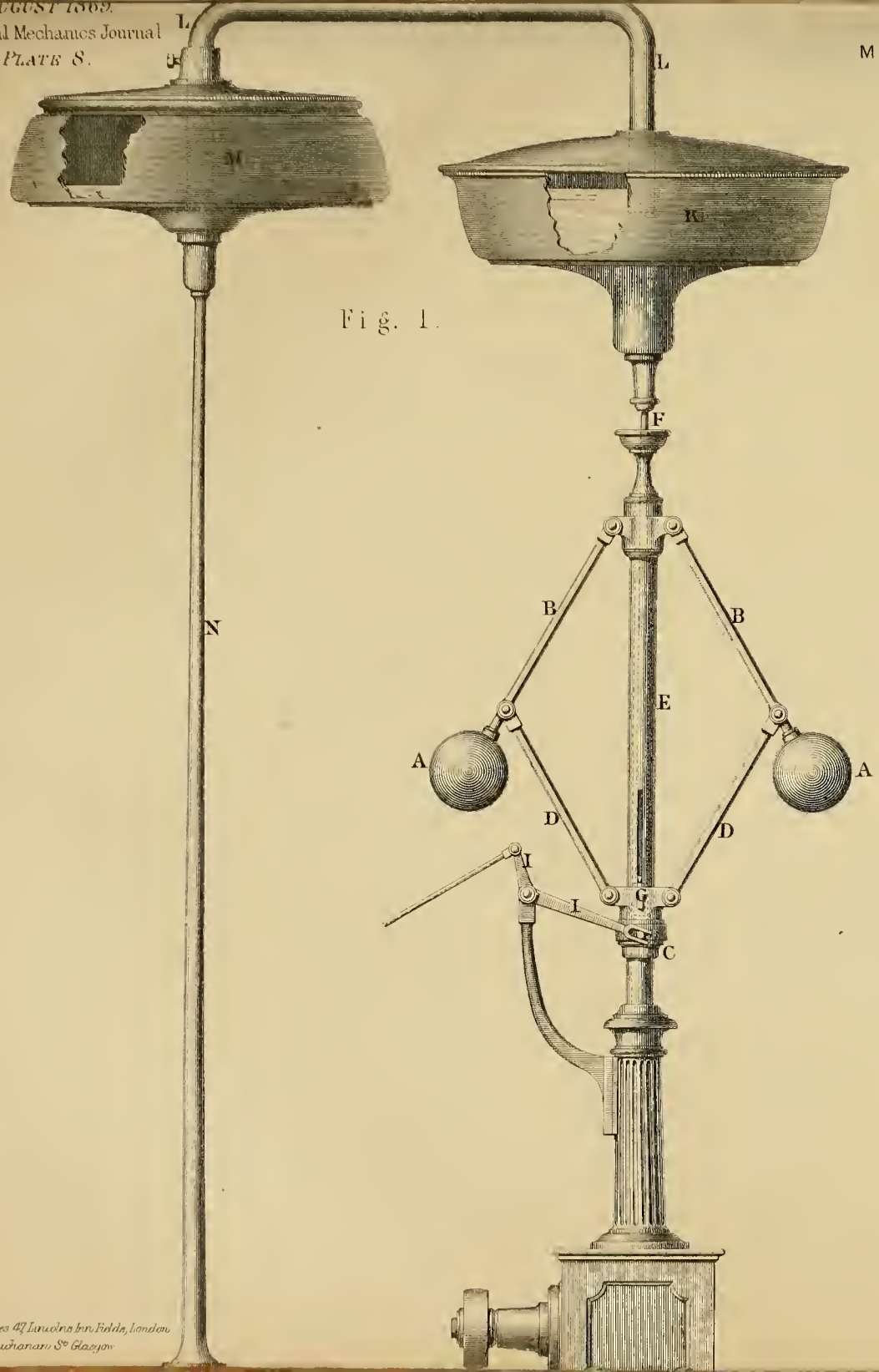
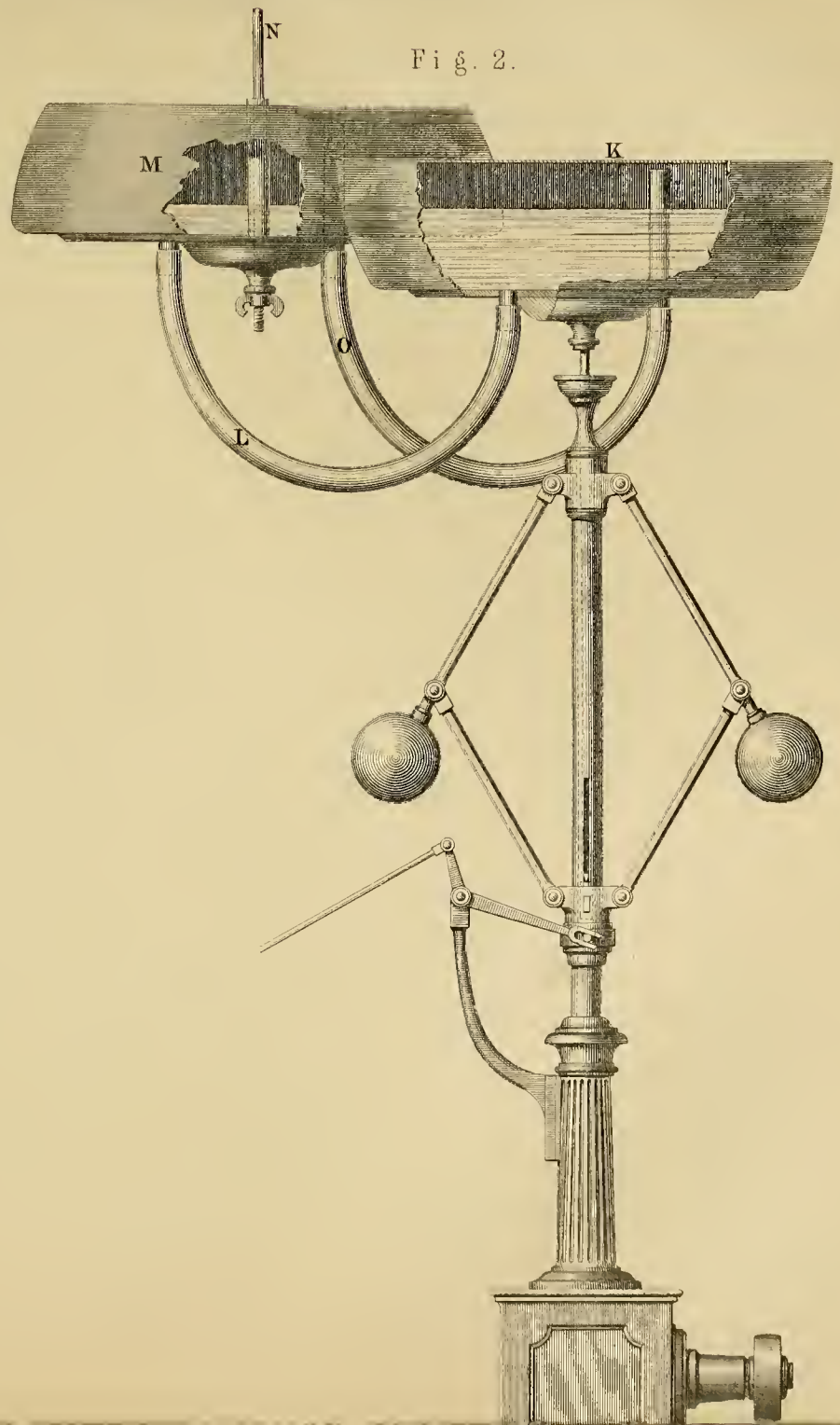



Fig. 2.




ent Offices 47 Lincolns Inn Fields, London
ed. 166 Buchanan St Glasgow

## ON SOME POINTS OF PRACTICE IN IRON-FOUNDING.
### No. XXXVIII.

*Air-Furnaces for Fusion; their Choice, Construction, and Management.*

The invention of the "reverberatory furnace," very commonly called, amongst iron-founders, simply the "air-furnace" (as contra-distinguished from the "blast-furnace" or cupola), mounts to a very high antiquity, though, probably, the earliest notices of furnaces, certainly belonging to the class reverberatory, are to be found in the writings of alchemists, and not prior to the thirteenth century. The reverberatory furnace is, however, an instrument of great ingenuity, flexibility, and delicacy, both in construction and in working; and its varied uses were almost fully comprehended by those early pioneers of chemistry, though none of their furnaces were of more than mere model size, as compared with the immense scale upon which such furnaces are now-a-days employed for chemical manufacture, for innumerable metallurgic purposes, and for the fusion of metals.

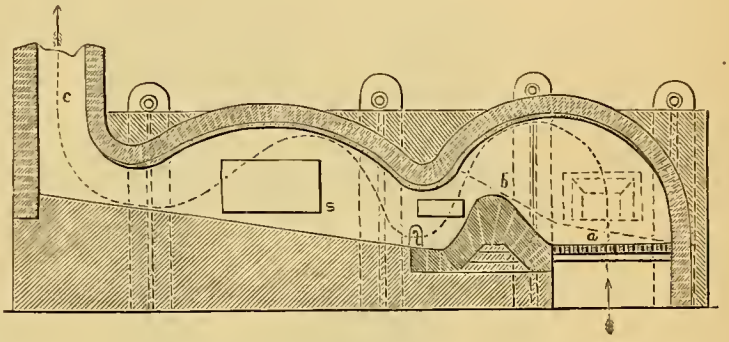
These different uses and applications of the air or reverberatory furnace have their origin in the fact that such furnaces may be so varied in construction and management as to be capable of performing anything nearly, that heat with access of fuel gases and air, can effect. Their powers, however, may be divided generally into four great classes :—

1. They may be mere *heating* instruments, not productive of chemical change, but merely ancillary to some molecular one; as when flints are so heated red-hot, in order to their subsequent reduction to a fine powder.
2. They may be *deoxidating* instruments, in which haloid compounds of metals &c. may be reduced, either by the chemical action of the fuel gases at a high temperature, or by these and chemical agents added in the furnace.
3. They may be *oxidating* instruments, operative by excess of atmospheric air passed through the fire, the oxygen of which at the high temperature becomes effective solely, or aided by chemical agents in the furnace.
4. They may be instruments for *fusion* of metals or of other substances, with or without more or less of chemical change.

We have given an example of the first class. The metallurgies of lead or of copper present many cases of the second. The metallurgy of iron in puddling, or of lead in producing litharge, are cases of the third; and we are here more immediately concerned with the fourth, as an instrument for the fusion of cast-iron for foundry use. It constantly happens also that the same furnace is called upon at different stages of the same process to perform different or opposite parts. Thus it may be used at first as an oxidating furnace; it may then, by increased supply of fuel, more air, or other changes, become a deoxidising furnace; and lastly may, by shutting up close, after full supply of fuel, and the best obtainable draught given, become a furnace of fusion. In making puddled steel, for example, the furnace, after acting by oxidation, has its damper closed, and becomes a deoxidising or neutral furnace, while the "ball" is being formed and drawn; and when employed as iron foundry tools for the fusion of cast-iron, it is inevitable that the air-furnace continually acts either as an oxidating, or neutral, or a deoxidising agent; and, in fact, it is this inseparable accident, and the impossibility of maintaining, even for a very short time, any one constant or known state of action in any reverberatory furnace, unless one fed by gaseous fuel only, that constitutes one of their greatest objections to the founder.

These varied purposes to which reverberatories are put, involve corresponding alterations in the proportions of their parts, often so great that the eye of an untechnical observer would scarce recognise two constructed for extremely diverse uses, as belonging to the same sort of furnace at all, or having in fact anything in common.

Fig. 2.




Thus, a reverberatory furnace used for roasting pyritose clay shale, at a very low red-heat, for alum-making, may consist of two immense rectangular low chambers, with level floors and roofs one above the other, each as long as a large dining-room, through both of which the flame and gases of the fire or fires silently and slowly circulate; but one for the rapid fusion of large weights of cast-iron, or, still more remarkably, of steel (as by the method of Mons. Sudré), will not be of one-fiftieth the external size, will have nothing within but curved and crooked cavities, and these when at work full of blindingly bright flame, rushing through, urged by a cutting draught that may be heard sighing or roaring at an hundred feet distance.

Yet, with all this diversity, every reverberatory furnace consists of strictly homologous parts, though variously disposed or proportioned. This may be seen in figs. 1, 2, and 3, which may be taken as types of three different constructions of furnace, all occasionally employed for the fusion of cast-iron (as well as of copper, bronze, or brass). In all three, *a* is the hearth or fire-place, *b* the bridge, *s* the sole or bed of the furnace; all being covered over by the roof or reverberatory arch or arches, usually curved both ways, *i.e.* from the side walls as well as from the ends; and *c* the flue or chimney-stalk, and *t* the tapping-hole, or temporarily stopped-up aperture, through which the fluid metal is tapped and let to run out.

Besides these, we have the air-vault or flue, bringing in the cur-

Fig. 1.

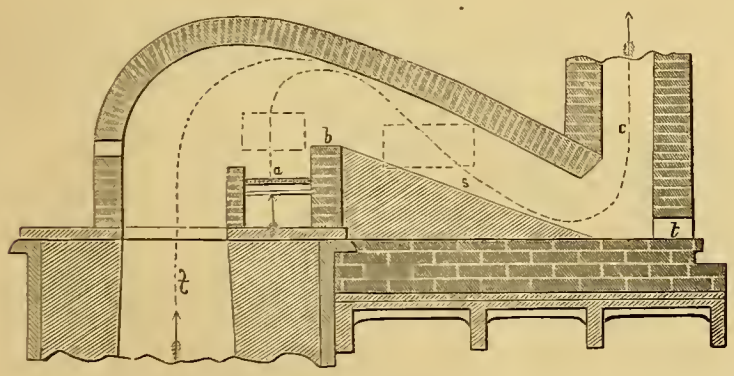
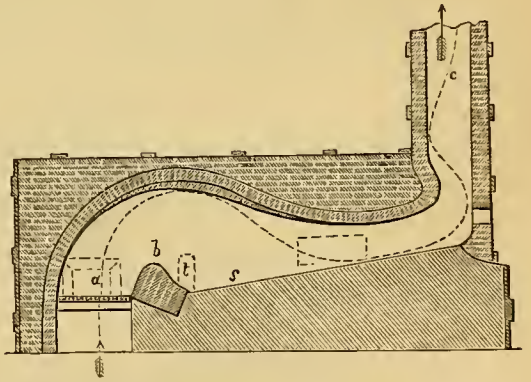
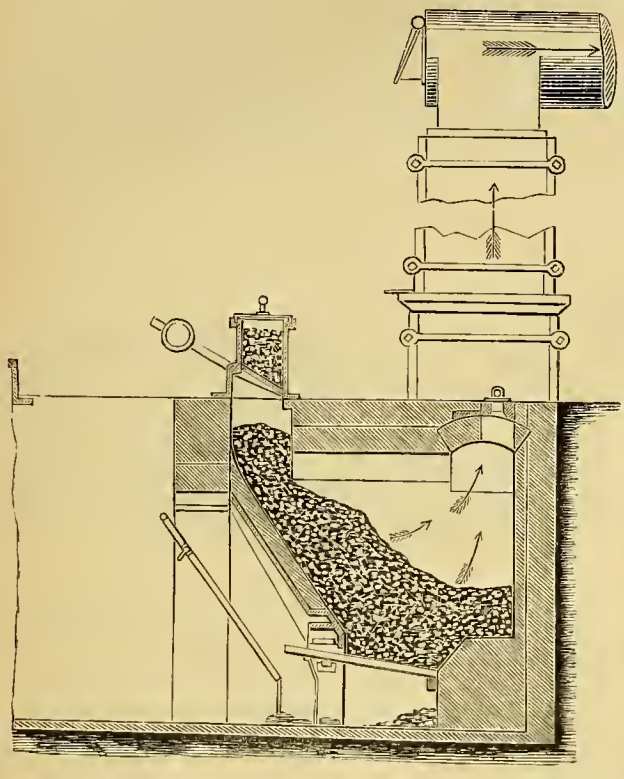



Fig. 3.



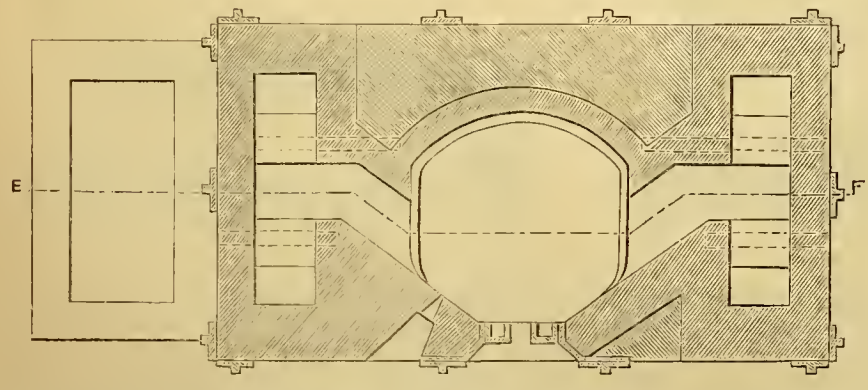
rent of atmospheric air to pass through the grate and fuel, and supply the place of that sweeping up the chimney; charging-doors for the sole, others for the supply of fuel; spy-holes of small size, to enable what is going on within to be seen without letting much cold air into the interior; and dampers, which are usually high up in the flue, or even on the top of the chimney-stalk, so as to

Fig. 4.



escape the great heat lower down. The bridge is always next the fire-grate, its function being, in fact, in conformity with the general form of the cavity of the furnace, to direct the course of the flame, and cause it *to reverberate* from the arch above and impinge upon the sole at the proper point, where the maximum heat &c. is desired. But the charging-doors may be greatly varied in number, form, size, and position, and the tapping-holes likewise. Thus, in fig. 1, the tapping-hole *t* is at the end remotest from the fire; in fig. 2 it is laterally placed between the bridge and the flue, and at about the middle of the length of the

Fig. 5.



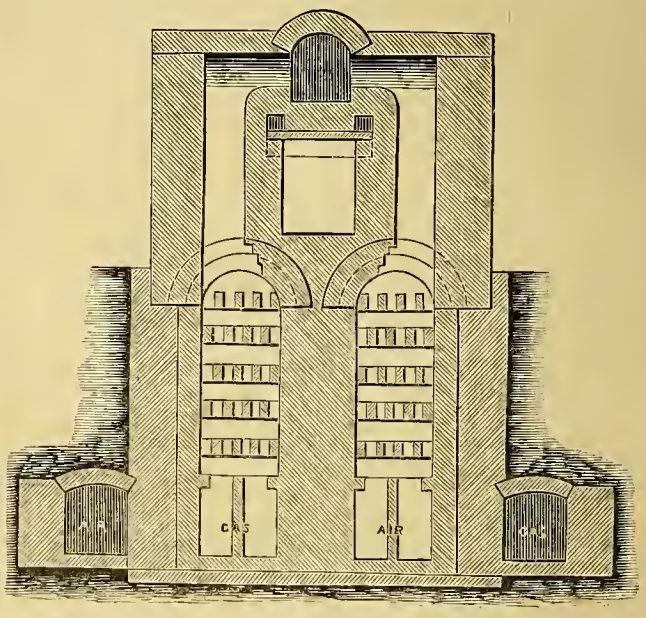

furnace; whilst in fig. 3 it is situated laterally close to the bridge, and at the fire end of the furnace.

Again, the sole may slope towards the flue, and the deepest part of the "pond," or "pool," or cavity of the furnace which fills with the liquid metal may be there, as in fig. 1; or the sole may slope towards the bridge, as in figs. 2 and 3, and the pool be next the fire-grate.

Or, as we shall see in other examples of approved reverberatories further on, the sole may be a deep hollow with curved sides sloping together, or it may be quite flat, so that the pool, when filled with liquid metal, is of nearly uniform depth.

It must be remarked, that although fig. 1 is here adduced to serve as an example of one form of these furnaces, it is not *simply* an air-furnace; it is a form devised by M. Guettier, for economising the waste flame and heat of a cupola, the top of the cavity of which is shown in part at *f*, fig. 1, and the flame and gases from

Fig. 6.



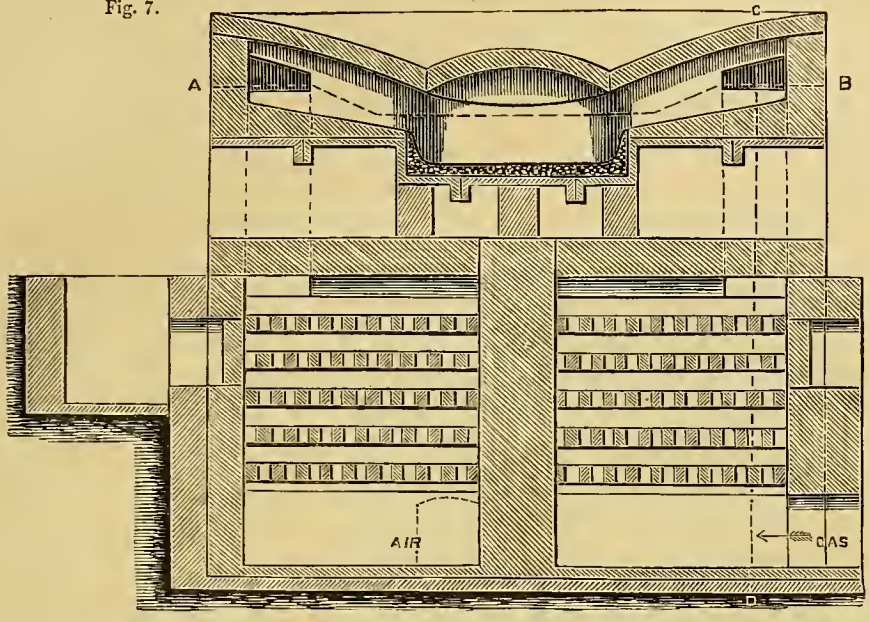

which unite with those from the small fire-grate, proper to the furnace, and unitedly reach the sole. In a former paper of this series, we have pointed out that *some* waste heat from the best constructed cupola of large size may be, no doubt, economised by piling the pig-iron to be melted into a long horizontal flue through which the waste gases &c. of the cupola have to be expelled by the blast; but if the cupola be well constructed and well worked, the waste heat is far too insignificant to render it ever advisable to endeavour to utilise it as thus proposed by M. Guettier.

However, as the proposal is that of a competent French founder, of about ten years back, and as in iron-works waste high-furnace gases may without doubt be brought in aid of the proper fire-hearth of reverberatories coming in as above *f*, fig. 1, we have let this fig. stand here as illustrative of the double object. We shall revert to it, probably, when we come to treat of reverberatory gas-furnaces of the Siemens construction.

The fundamental characteristic of every reverbcratory furnace designed to produce a high temperature, and effect the fusion of metals of difficult fusibility, is, that it shall be, in fact, a gas blow-pipe. The temperature of flame resulting from the same fuel and air, *i.e.* under the same chemical and other conditions, and assuming no heat lost by radiation &c., is always the same, and approaches the theoretic limit as to temperature. To heat a solid always losing heat, as nearly to the temperature of such flame as possible, we must direct such a current as shall bring the greatest number of particles of flame into contact with it in an unit of time. This is, in fact, the nature of the action of the common mouth or table blowpipe, and is the sole reason why we can produce so much higher a temperature by their means than we

can by the flames of a candle, a spirit-lamp, or a "Bunsen" gas-burner, though the flame is about at the same absolute temperature in all of these. And, far more strikingly, the principle of the apparatus is the same whereby, with the flame of the oxyhydrogen blowpipe (initially hotter than air-fed flames) rapidly streaming into a cavity, whose walls lose almost no heat, and impinging or reverberating upon a given central area, Mr. H. Saint Claire Deville has been able to melt with ease, into one ingot, thirty or forty kilogrammes of platina.

Fig. 7.




Now, every reverberatory furnace is a gas blowpipe; the flame, or rather its central and hottest thread, or sheet, being so directed and led along, by the form of the cavity of the furnace, that it reverberates or impinges just about those parts (usually of the sole) where the maximum heat is required. This will be understood by considering the course of this central thread, as represented by the dotted lines, terminated by arrows, in the three figs. 1, 2, and 3, wherein it will be seen rising through the fire-grate, impinging upon the reverberatory arch above, under the directing influence of the bridge, thence being deflected downwards to impinge upon the sole once (or oftener, as in fig. 2), and finally passing off.

What we have to effect, then, in constructing an air-furnace to fuse cast-iron, given the quantity by weight and volume to be melted at once, and within rather loose limits the time for its fusion is, first, to proportion the "sole" and "pool," so that they shall be able to hold the "charge." Then, having decided (usually in reference to local circumstances) the position for the tapping-hole and grate, to fix the size for the latter, and for the proper volume of fuel to be in combustion together; and lastly, to determine the curves and general disposition of the reverberatory or covering arches forming the roof of the furnace in reference to the positions of the fire-grate and the bridge, so that the central thread or sheet of flame shall impinge upon the metal to be fused, in the right place and proper direction. It will be easily understood that it must not impinge too near the bridge, nor yet too far on; if either, it may still fuse, but with great loss of time and fuel. The function, then, of this hottest central column of flame, thus brought continually against the same area, being to effect the most the heat can—*i.e.* to fuse as rapidly as possible—the function of all the remainder of the flame, as it streams off to the flue, is to keep the walls and sole of the furnace hot, and so conserve or confine the heat delivered into the charge, and prevent its being dissipated by radiation. And again it becomes obvious that if we are to produce the best effect here, or, indeed, in any furnace, we must not let in any needless elements of cooling along with the air needed to consume the fuel and source of our heat. We must burn enough pounds of fuel per second to give us the volume of flame necessary fully to sweep through and occupy the entire cavity of the furnace; we must give that sufficient velocity, by means of sufficient chimney draught, that it shall obey our intentions with respect to the points of the sole fixed for the reverberation to be operative, for it is manifest that the draught might be so slow that little or no deflection of the sluggish stream at all might occur, while it is equally plain that any very great change in the velocity of the current will, if accelerated or retarded, cause the points of reverberation to change position on the sole, further from or nearer to the bridge.

But while we admit enough air—and this must always be more in volume than mere chemical combination with the carbon and hydrogen of the fuel alone would indicate—we must guard against admitting too much, the excess being simply so much cooling agency, acting on the fuel, or the charge and walls, or on all.

Fig. 8.

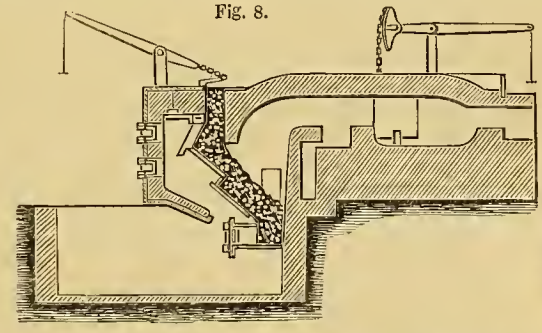


Fig. 9.

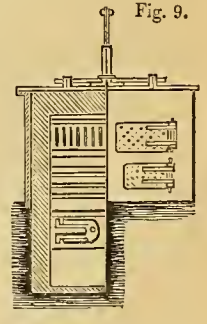
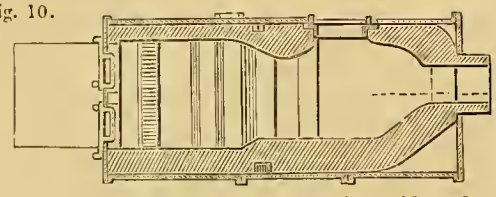


Fig. 10.



Above all, we must not admit accidental streams of actual cold air, either by cavities on the grate bars, left bare of fuel by bad stoking, or by leaving fissures and cavities in the charging-doors, or other needful occasional apertures, or by working an old furnace after the brick-work has got so shaken as to be full of open joints and cracks.

As these furnaces, then, are in fact huge blowpipes, they must,

for fusion, operate by *flame*, and hence their proper fuel is flaming fuel.

Coke alone possibly, by help of a powerful draught, *might* be with difficulty and vast waste employed; but long flaming fuel answers best, so that bituminous coal is the best possible; but as to *its* quality, there is something to choose. Gas fuel, upon the regenerative plan, as well as upon that of the concentrated blowpipe flames, like those of Deville, have been employed with furnaces of this class.

And in figs. 4, 5, 6, and 7 a Siemens gas reverberatory furnace with its gas producer (fig. 4) are shown; and in figs. 8, 9, and 10 the reverberatory of Wilson, with the gas producer attached to it. Some difficulties have attended their use, notwithstanding the immense advantages of the regenerative method in exalting temperature, due to the flame not impinging properly, but these are no doubt removable by a proper disposition of draught &c., to which we shall return.

We have now given a general sketch of the history, functions, and form of reverberatory furnaces, and shall in a succeeding article treat of their proportioning and construction more in detail, as well as of their working or management, and, by the help of some good examples, point out the advantages and disadvantages which, as compared with the cupola, these air-furnaces offer to the iron-founder.

## SOME NOTES ON THE PRESENT STATE OF VINE CULTURE AND WINE MAKING IN FRANCE.

The greatly increased and still expanding trade in French wines, which has sprung up since the Cobden Treaty, and the importance, in respect of the moral advancement of our working-classes, of a freer supply of light wines, justify our giving our readers the following notices.

The vine occupies at the present time in France nearly 2 millions 500,000 hectares, the one twenty-first part of the French territory, and about the one sixteenth part of her cultivable soil. Its raw product direct amounts in value to more than 1 milliard 500 millions of francs; and it maintains 6 millions of cultivators and nearly 2 millions of tradesmen, manufacturers, carriers, and retail traders, representing altogether the production and consumption of, at least, 2 milliards of francs. The vine is cultivated in seventy-nine different departments, from that of the Gironde, which counts more than 150,000 hectares, to the department of Ille-et-Vilaine, which possesses only 104 hectares. In forty-eight departments, the vine produces not less than a quarter of the total agricultural annual revenue, and supports a fifth of the population; in sixty-nine departments, it still occupies an important part in agriculture; and in seventy-nine departments its products are from three to six times greater than those of all the other great cultures or crops; it doubles everywhere the revenue of landed property, great or small, where its culture extends over one-fifth of the area. The culture of the vine is the easiest, the simplest, and the most remunerative of all agriculture; it can begin to yield its remunerative products from the third year; it accommodates itself to all geological formations; it prospers in the driest soil and in those which are the least suitable for corn, root-crop, vegetables, or fodders and hay; or it thus also constitutes the implement of all good agriculture; for it is like a sleeping partner, in virtue of the money which it produces, and it is the resource of the farmer by the arms and mouths which it maintains.

Wine, its product, is the most precious and most energising of all alimentary drinks. The use of it is deemed to save the half of the bread otherwise eaten; and more than bread and meat does it stimulate the body. It animates the heart, develops the spirit of sociability, and gives to work and action, mental or bodily, activity, courage, and contentment. No other drinks, such as beer, cider, &c. &c., can replace it in these its happy influences. The future thus belongs to it, and it will ultimately constitute the alimentary drink for the meals of families, wherever civilisation shall have extended its benefits. The normal consumption of alimentary wine should, in order to give to human society co-operatively all its powers and all its activity of body and of spirit, at least equal that of bread; that is to say, that France alone should consume nearly 100 millions hectolitres with her actual population, and more than 100 millions, allowing for the necessary growth of her population. Now, France produces scarcely 75 million hectolitres of wine. Notwithstanding these benefits derived from the vine through wine, its product, long consecrated by religion, by the oldest traditions, and still more by the experiments and observations of the last century or so, study and instruction in the culture of the vine and in the art of making wine — although they have been the objects of the attention, and the text of the works and publications of some eminent men of all periods and of all countries, and objects of the solicitude and patronage of churchmen and sovereigns—have never been admitted into any one of the official courses of public instruction. Even in France, where the vine and its products constitute not only a fifth of the private and public wealth, but also one of the largest sources of revenue of cities and of the state, the public studies and instructions, so judiciously granted to agriculture by the state, have not comprehended amongst their objects this most important and most national branch of all French cultures. And hence in France the strangest and most opposed practices, which seem to contend and even to exclude each other in an almost infinite number, are applied without rule or principle, without any guide which codifies them, and without any system which allows their relative values to be compared and appraised. Each province, department, and wine-growing district is convinced that its own traditional culture of the vine is the best possible; that it constitutes the last word of art and science in the wine trade; and each vine-grower is himself convinced that the vine cannot be cultivated, and that good wine cannot be made, in any other manner than his own; thus, the really good process of one can never be of any advantage to the others, and the management of the vine and of its wines is abandoned to a thousand odd and narrow practices, to almost a complete anarchy, without any possible or logical progress or improvement. Nevertheless, there is scarcely a wine-growing centre which could not offer some one useful and fruitful process of culture amongst ten other ones which diminish and destroy the good effect perhaps, of that. There are, no doubt, many districts where the culture is on the whole very satisfactory; there are some which approach to perfection. It is, however, important, in order to lay the foundation for advanced knowledge and instruction in vine culture, to study with care and impartiality all systems, all methods, all processes of culture anywhere pursued, to set them forth clearly in print and by engravings, and to arrange the means of information in such a manner that every vine-grower and agriculturist can understand and compare them, and deduce, as respects himself, that method of culture which he concludes to be the best.

It is not to be understood that the vine and its juice are without a literature—far otherwise; there is probably not a wine country in Europe which does not possess works by private authors on these subjects, and there are many works on wine by authors natives of countries too cold for the vine.

But these are not exactly what are needed by the vine grower, who wants full and authoritative information not only as to what all his neighbours, near and far, do, but as to the condition, climatical and otherwise, under which it is done. One of the most important and valuable works in French upon the subject is the volume *Sur Viticulture* of M. Ladrey, Professor of Chemistry at Dijon, in the Côte d'Or, a work well known and much consulted; but it is not possible for any one professor to present the panoramic and authoritative detail needed now by the wine-growers of Europe.

The production of such a work is the task which Dr. Jules Guyot has undertaken, under the auspices of the Minister for Agriculture: it was commenced in 1861, continued during the six following years, and brought to a good conclusion only in 1867.

These studies comprehend the seventy-nine departments of France where the "*vigne à vin*" is cultivated. Each department has been the object of a separate and special study made amongst the vines and vineyards, and with the concurrence of the proprietors of the soil and the vine-growers. This report conveys in print and with illustrations, in a first or preliminary manner, to the Minister for Agriculture all the local suggestions which may have been collected, whether technical or economical; then follows, after all, the series

of explorations and enquiries—the abstract reports, which have been put together so as to form, with the notes and the very detailed sketches &c., a general report of the entire explored district.

It is thus that the work embraces eight general reports. The south-west, the south-east, the east, the west, the north-west, the north-east, the central south, and the central north, have been explored successively in the space of six years, and the results laid in a complete manner before the Minister for Agriculture, who has commanded the printing and engraving and the publication of the entire eight parts by the Imperial printing-office at Paris. Each number has then been forwarded by the Minister, at first to the principal vine-growers of the corresponding department, next to all the vinicultural and agricultural societies of the departments where the vine is cultivated, and finally, to the members of the assembly and Great Council of State. After these trials and methods of control had satisfied the agricultural world and the Administration as to the information obtained, the Minister again invited Dr. Jules Guyot to terminate his labours by the production of one complete work, which should embrace in one view all the departments previously described and discussed, in all their details relating to the culture of the vine and the art of making the wine, so that the information should be codified into a comparison and general criticism, with all consequences, considerations, and deductions which properly have arisen. This work Dr. Jules Guyot has finished now.

The publication of it has been entrusted to MM. Victor Masson et fils, Paris, who on their part have assured perfection for their edition by employing the typographical superiority of the Imperial printing-office, having obtained permission for having the work executed by this incomparable establishment. "*Les Études des Vignobles de France, pour servir l'enseignement mutuel de la viticulture et de la vinification françaises,*" form three volumes, royal 8vo., containing about 2,000 pages of text and from 1,000 to 1,200 engravings, which explain in an analytical and practical manner every process of the planting, renewing, the pruning, the training, and the general management of the vine, by all the methods applied or in use in France.

This work is really a national monument, and conveys more complete and trustworthy information in all that relates to French vines and French wines than, so far as we are aware, has ever been found collected before.

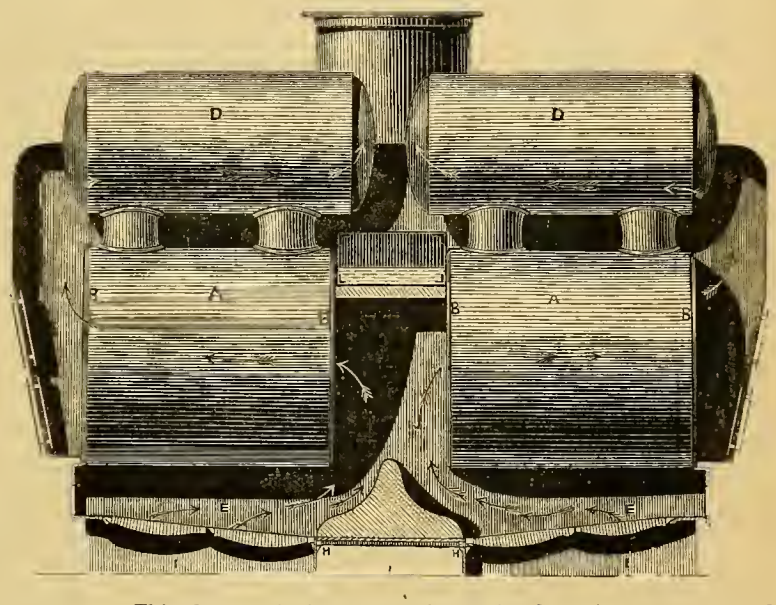
There are some great cultures with ourselves upon which like digests might not be amiss; notably let us suggest flax, sugar, and cotton. There are piles of books and reports about all these, but where shall any man—cultivator, man of science, legislator—look for any one work in which, in a codified and authoritative manner, he can at once lay before himself all that is known upon these nationally important branches of agriculture, and manufactures growing out of that?

## CRAWFORD'S STEAM BOILER OR GENERATOR.

(*Illustrated by Plate* VII.)

The boiler or generator represented in plate VII. is the invention of Mr. Bartholomew Charlton Crawford of Newcastle-on-Tyne. The invention will be clearly understood on reference to the plate and accompanying wood engravings. Fig. 1 on the plate is a front view; fig. 2 a longitudinal vertical section taken through the centre of fig. 1; fig. 3 a vertical transverse section taken through the line 1–2 of fig. 2; and fig. 4 a transverse vertical section taken through the line 3–4 of fig. 2; A is a plain cylindrical vessel forming the body of the boiler, having two ends B B which form the tube plates, and in which are inserted, in the usual manner, the ends of the tubes or flues. This cylindrical vessel is intended to be placed horizontally or slightly inclined, and to be nearly filled with tubes or small flues, a sufficient number of which are arranged to act as stays to the flat tube plates, having the requisite water spaces between them. At the upper part C a certain space is left clear above the water line to allow of the ready escape of the steam from the surface of the water as it is generated. On the top of the boiler, and connected to it, is a large cylindrical steam chamber or receiver D for collecting the steam and partially superheating or drying it. The furnace E is formed underneath the boiler, the sides being constructed of iron boxes F, with water spaces formed in them; they are lined with fire-brick G or other non-conducting substance next the fire. The bottom of the boiler thus forms the top of the furnace, and the fire-bars and grates are carried on bearers H fixed to the sides and provided with ashpits I below. At the back end of the boiler is the combustion chamber J, forming an iron casing K filled with water to a certain height, and communicating with the water spaces of the furnace sides.

Fig. 1.



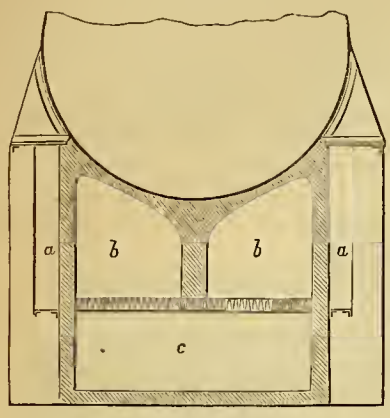

This chamber is lined throughout with fire-brick, and surrounds the whole of the back tube plate, the ends of the tubes opening into it to receive the flame and gases generated in the furnace, which, after passing through the tubes, enter a smoke-box or chamber L at the front end, and are then conducted by a flue or flues surrounding the steam receiver or chamber D to the chimney.

The water contained in the side spaces of the furnace, and in the casing of the combustion chamber, is not liable to be under pressure, being simply intended to absorb and utilise the surplus heat given out by the fire-brick linings, and is supplied from suitable reservoirs or tanks (by gravitation or otherwise) kept at a uniform level, being pumped into the boiler as feed water as it is heated in the water spaces; and should any steam be generated from this water (though this is not anticipated), it will be taken away by an escape-pipe M at the top of the combustion chamber casing.

In order to protect that part of the boiler forming the top of the furnace from injury by the fire, owing to the deposit of sediment in the concave part of the interior, the inventor provides one or more pipes or pockets N into which all sediment will subside and be blown out by proper cocks. These pipes or pockets may, if necessary, be protected from the action of the fire by fire-brick cases; or the bottom of the boiler over the furnace may be entirely removed from the intense heat in the furnace by being lined with arched fire-brick, so that the flame and gases generated in the furnace will be concentrated in the combustion chamber J at the point of entering the tubes or flues. When it is required to use two or more boilers they can be set side by side or back to back as shown in the wood engravings (see fig. 1), in which latter case the inventor arranges them in such a way that one combustion chamber J is common to two boilers; in the duplex plan the construction of the other parts is the same as in the single boiler. Fig. 2 of the wood engravings is a section of a furnace showing fire-brick lining to protect the bottom of the boiler; *a a* are the water spaces, *b b* the fire-bars, and *c c* the ashpit.

The principal advantages derived from the boiler or generator here described, are—First, simplicity of construction ; second, the capability of using, with safety, steam or gases at very high pressures, no part of the boiler or receiver being subject to collapsing pressure except the tubes, which, being of comparatively small diameter, are well able to sustain it; third, the non-liability to priming, the circulation being easy, and a large steam space being provided ; fourth, lightness of the boiler in proportion to the working pressure, and the great reduction of the weight of water to be carried. In addition, it is thought that the cost of the boiler, in proportion to the working pressure, will be less than that of any other high-pressure boiler of equal power.

Fig. 2.




Although the cylindrical form is preferred to any other, the body of the boiler and the receiver may be made oval, rectangular, or of any other shape, by the use of stays ; but for high pressure the cylindrical form of boiler is preferred.

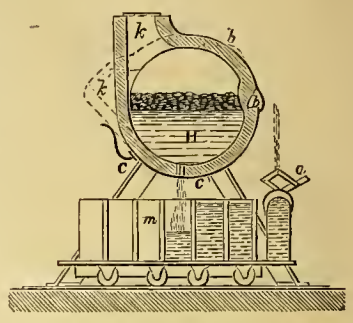
It is believed that the fire-brick linings of the furnaces and combustion chamber will have the effect of reverberating and intensifying the heat of the gases in the same way as in a reverberatory furnace, and that they will act as reservoirs for heat to be restored according to the requirements of the evaporation.

## NOTES FROM FOREIGN JOURNALS, OR AUTHORS, ON STEEL MAKING.

The following miscellaneous notices may prove interesting to such of our readers as do not themselves consult German and Swedish journals or other publications :—

Nyström recommends a modification of the Bessemer process. In order to obtain the most intimate contact between the liquid iron and the rays or streams of the air blast, the latter enter generally near the bottom of the converter apparatus. In the Swedish converters the twyers are generally fixed in an excentric position, so that the rays of blast are parallel to adjacent tangents to the circumference of the lining, whereby the mass of liquid iron gets into a vehement fluctuating and rotating motion, which, though rendering the conversions more rapid, rather prevents the removal of the impurities, and admits of only the use of the best sorts of pig-iron ; for otherwise an addition of "*Spiegeleisen*" is required, in order to recombine with the metals the necessary carbon, and to unite the sulphur and phosphorus in a great measure with the manganese added therein. The apparatus of Nyström is worked at Gloucester near Philadelphia, in the United States of America. The liquid metal H (fig. A) is exposed to the influence of the blast, which passes through twyers *b* immediately under its surface, and, the oxygen of the air combining with a part of the carbon, carbonic oxide and carbonic acid are formed, which escape with the nitrogen, &c. through the aperture *k* ; while, through the oxydation of the silicon and of some iron together, a stratum of dross is produced, the upper part of which is composed of silicic acid mainly, with alumina and lime, &c., but the lower side of the stratum, which is in contact with the iron, consists of iron-silicate. A most important reaction then takes place between this dross and the liquid iron beneath it, analogous to that in the puddling furnace. But the temperature in the latter furnace is never sufficiently high to produce a sufficiently liquid metal for the separation of the slags or impurities without the aid of the shingling hammer, and these are even not removed completely by shingling and hammering ; in Nyström's process, however, so very high a temperature exists in the converter as to keep the metal for a sufficiently long time seething and circulating as a liquid, whereby the sulphur and phosphorus have time to combine with the oxygen compounds of the dross or slag. The whole mass receives very slowly a tumultuous motion, which brings gradually each part before the twyers. This process requires more time than the usual one, (*i. e.* with the English converter), but it allows an easier inspection and gives better and more regular products. By proper regulation of the blast, and according to it, the course of the other parts of the process, any kind of pig-iron, Nyström affirms, can be transformed into bar-iron or into steel of sufficiently good quality, certainly as well, if not better, than in the puddling furnace. After the process is finished, the apparatus is turned over in such manner that *k* comes to *k'*, and the tapping plug, or stopper c, into the position *c'*; on removing the latter, the metal runs directly into the ingot moulds *m*, which are shoved along, one after one, upon a carriage on rails. After the ingot has got sufficiently cold, it is drawn from the mould and put aside by means of the strong pair of tongs *a*.

Fig. A.




In all this last there is nothing new to English practice ; there does appear to be a positive advantage in economy and time, however, in thus tapping out the converter at the very bottom—in place of upsetting it into a ladle as done by Bessemer.

Amongst *other methods of Steel Production abroad*, P. von Tunner, who reported, on occasion of the Paris Exhibition, upon the progress of the manufacture of steel, gave account of two others represented there, besides the Bessemer process, both being in the French department. The one, invented by Bérard, and under trial for some time at Montataire Works, is only a modification, and, as the inventor himself says, an improvement upon the Bessemer process. The exhibited steel specimens looked extremely good ; but M. Tunner takes it only for a casually successful production, and, after what he has himself observed at Montataire, cannot adjudge any great future to this innovation. He deems more important the other process invented, or rather combined, by Emile Martin, and already to some extent applied more than two years ago. This process contains conditions already generally known and proved to a certain extent, and therefore, beforehand, suggesting some confidence in its utility. The chemical part of this (Martin's) process, is principally borrowed from Uchatius's anterior process for the manufacture of cast steel, but executed without crucibles, by which it is cheapened. Martin conducts the melting process, not in crucibles, but in a gas furnace, with Siemen's regenerators, which produce, as is known, so high a temperature, that it is possible by it to melt in crucibles or in the furnace itself, in a proportionally shorter time and in larger quantities, not only steel, but even bar-iron. Steel melting without crucibles is however nothing new, for it was tried in the years 1860 and 1861, by inducement of the Emperor Napoleon, at Montataire, and with some success on the part of M. Sudré ; but there, and also later and at another place and work in France, finished steel, of the best quality, has been remelted without having been injured ; probably something corresponding to regenerators for the heating of the air and gases were applied. Tunner considers this method of Martin's suitable for the mottled and white sorts of pig-iron, and for Upper Austria and Hungary as of special importance ; moreover, in comparison with the Bessemer process, it may be carried through with less preliminary expense, and upon a moderate production prove more profitable. The Bessemer process is certainly preferable to the one of Martin, for such sorts of pig-iron as are suitable for it, and for a larger production ; but in many localities, where the Bessemer process is not applicable, the method of Martin, he thinks, will find its place. As the Exhibition proved, and as is evident from the nature of the matter, not only steel, but even bar-iron, at least fine-grained iron, may be kept perfectly liquid after this method ; and from the rather harder sorts may be produced different castings, as has been done

lately very often from the Bessemer metal or so-called steel. Gun barrels, of which the French Government ordered, again, in 1867, 150,000 pieces, were a chief article then of the production of Martin's method. The material employed in these barrels distinguishes itself by its toughness ; and as a proof of it a barrel was exhibited which did not burst even under the established proof *a l'outrance*, but only cracked in one place, and without losing a single splinter. The method is patented in France, and M. Verdié, in 1867, bought the patent for the works at Ferminy, where the method is to be carried out to a large extent ; while, up to the date of Tunner's Report, it is said Martin had only produced 2,000 cwt. monthly.

All these are very favourable and flattering statements, and, no doubt, appeared fully justified to Tunner. But, in contrast with them, are some very remarkable facts as to failure in Great Britain of the Siemens-Martin process—if the statements be correct, that Messrs. Samuellsons & Co., of Middlesboro', after spending great sums, in plant and experiments, to manufacture upon the very largest scale, have given up the process in despair ; and that M. Siemens' own experimental works at Birmingham, so far as the Siemens-Martin process is concerned, are also no longer at work. It is extremely hard, in England, to get at the exact truth in cases like this, where great interests, as well as metallurgical facts, are both alike involved.

Tunner notices a great number of isolated specimens of steel manufacture, exhibited in 1867 ; and, amongst these, some from Great Britain, with much approval. Bury & Co., of Sheffield, exhibited, in the English department, bar or wrought-iron, melted in crucibles, which may be worked up immediately into tools—as, for example, for screws, for parts of tools, &c. ; and can be transformed afterwards, by cementation, superficially into steel. This peculiar process has in view to enable a finished piece to be kept symmetrical, and yet be made as hard as possible ; for such, if made of hard cast-steel, get, upon complete hardening, warped, and are so brittle as to break in use easily; and if bar-iron be used for them as made by rolling, but which had not been transformed by re-melting in crucibles, into a homogeneous and sound mass, the finished pieces might not offer the same security, but break partially, or, as hard cast-steel very often breaks during the hardening. The Wikmanshyttan exhibited, in the Swedish department, cast-steel, produced according to the method of Uchatius, which, it seems, remains in Sweden still in constant use. The excellent, rich, and pure magnetic iron-ores which are at the command of Wikmanshyttan works seem to have there gained for this process a satisfactory result, for the steel produced is said to possess, combined with its great hardness, a high degree of toughness. A considerable quantity of this steel, in bars of different dimensions, is sold at $16\frac{8}{10}$ to $18\frac{9}{10}$ thalers (56–63 shillings) per zollcentner or per cwt. at the works.

The mint in Stockholm prefers, for its dies and rollers, this steel before any other one. The method of Uchatius to produce steel without the use of crucibles, as in the Martin process, has one principal advantage, that the dross produced can be taken away, and a new proportion of ore or of pig-iron may be added, if the sample taken should show that is necessary or desirable. The principle of Uchatius's method is therefore of far greater value for application without crucibles than for melting in crucibles. The Bessemer foundry of the united Dannemora works showed also, in the Swedish department, remarkable progress, as it substituted for the old celebrated cementation made bars, manufactured by the Walloon forge, Bessemer steel, which is imported into England, and there remelted in crucibles for the production of the best sorts of cast-steel, having been previously carefully sorted. The heavy costs, both of the Walloon forge, which consumes much charcoal, and of the cementation, are thus for the greatest part saved. Mild and close Italian cast-steel, chiefly used for the manufacture of revolvers, was exhibited by Glisenti in Pisogne (Lombardy) in the Italian department. This steel was produced by the now well known method of melting together spiegeleisen and bar-iron. But the peculiarity is, that the spiegeleisen, obtained for this steel from the furnace, is at first purified by an addition of 5 per cent. of manganese added, and then remelting it in crucibles. This altered spiegeleisen looks very well, and appears likely, under certain circumstances, Tunner thinks, to be useful. The Italian department also contained puddled steel, exhibited by J. A. Gregorini of Lovere (Lombardy) ; this steel was produced by the use of mixed fuel of second-rate quality in gas furnaces with Siemens' regenerators, and seemed to be of good quality. There were then annually produced in those works about 16,000 cwt. of steel, and about 10,003 cwt. of hard iron, for agricultural implements. The jumpers, or drills, for the Mont Cenis tunnel, are said to be made of this steel. The Bessemer process has made rapid progress in Prussia, at least as respects the quantity, as was evident even in 1867, from the data presented at Paris. Altogether, the manufacture of steels of all sorts in Prussia, of late years, has most extraordinarily increased ; the Prussian production was, in round numbers in the following years, as below :—

| | Iron. Million Thalers. | | Steel. Million Thalers. | | Altogether. Million Thalers. | |
|---|---|---|---|---|---|---|
| 1860 | 26 | £3,900,000 | 3 | £450,000 | $47\frac{1}{2}$ | £7,125,000 |
| 1861 | $24\frac{1}{4}$ | 3,675,000 | 5 | 750,000 | $49\frac{1}{4}$ | 7,375,000 |
| 1862 | $28\frac{1}{2}$ | 4,300,000 | $5\frac{1}{2}$ | 825,000 | $56\frac{1}{2}$ | 8,475,000 |
| 1863 | 30 | 4,500,000 | 7 | 1,050,003 | 61 | 9,150,000 |
| 1864 | $33\frac{1}{2}$ | 5,000,000 | 13 | 1,950,000 | 71 | 10,650,000 |
| 1865 | 35 | 5,250,000 | $15\frac{1}{4}$ | 2,300,000 | 79 | 11,850,000 |

The value of the production of iron has therefore increased in the course of five years, from 1861 till 1865 inclusively, as much as one-fourth, but the value of the production of steel, in the same time, has become *five times* larger. In order to understand the nature of the enormous increase, latterly, of the production of steel in England, Prussia and France, it is only necessary to consider how vast is, in England, the produce of the hematite ores (pure red and brown Hæmatite) ; in Prussia the great production of spiegeleisen in the country of Siegen, and in France the immense importation of pure ores chiefly (*oligiséts*) from Algiers, from the isle of Elba, and from Sardinia ; all these have prodigiously increased during the last fifteen years, and almost nothing but coke and coals have been used as fuel for their treatment. The development of railways, the increasing introduction of machinery, and the ever-growing applications of iron for bridges and other structures, and the wants of many nations for war-materials, account for and consume this increased production. Those countries (as Austria, Sweden and Russia) which have based their manufacture upon the use of vegetable fuel, would hence not be expected to present any great share in the development of the last fifteen years of iron and steel industry, and in fact their respective iron trades must sink before those of the coal-bearing nations.

## ON INSTRUMENTS FOR INJECTING AND EJECTING FLUIDS.

(*Continued from page* 88.)

Our former article concluded with describing several arrangements of ejector and blow-through condensers, as they have been arranged by Messrs. Barclay and Morton respectively. We have now to speak as to the efficiency of the apparatus ; and for this purpose, at the same time to enable our readers to judge at once by the eye, we append the best and only reliable tests—indicator diagrams—of engines supplied with both.

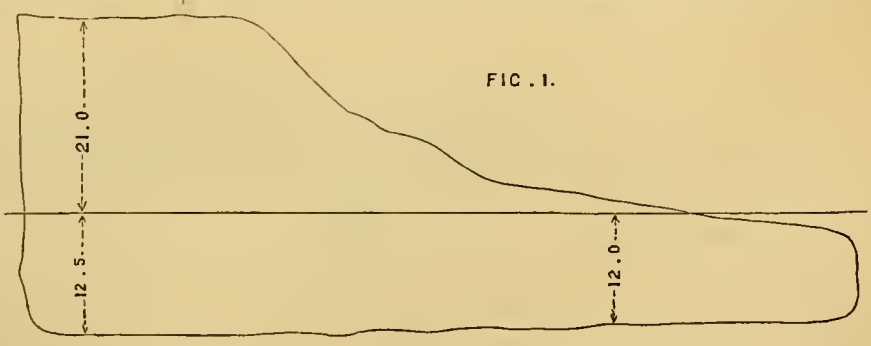


FIG. 1.

Figs. 1, 2, 3, and 4 are diagrams taken by Professor Rankine from

a pair of vertically inverted direct-acting steam-engines of about 24 indicated H.P., fitted with the ejector-condenser at the works of Messrs. Neilson Brothers, Glasgow. In these engines, as the diagram shows, the steam was cut off at about 0·2857 of the stroke and expanded at the termination down to −2·5 lbs. to −5 lbs. below the atmosphere, and the mean vacuum averages −12 lbs., so that the total effect of the condensation was to increase the vacuum by −9·5 to −7 lbs. and heat the feed-water, which, in the experiments referred to, was raised in temperature 36·5° Fahrenheit, from 47° to 83·5°. The instrument on which Professor Rankine's experiments were conducted was arranged by Mr. Morton; but it appears as thus arranged to have been defective, in so far that it used a greater amount of water than is wanted for either the old injection-condenser or the surface-condenser. Of course we must bear in mind that, with a less quantity of water, the temperature with a given quantity of steam condensed would be higher; but this would have the effect of forming aqueous vapour, the presence of which would tend to diminish the vacuum; and herein, it appears to us, another grave defect of what is alleged to be Morton's ejector-condenser exists, depending, too, on the fact that the nozzles of the apparatus are *fixed* in place of being *adjustable*, so that the areas of the steam nozzles cannot be adjusted to the quantities of steam passing through the cylinders, according as the engine is working "light" or "heavy." With fixed nozzles it follows that, if they are arranged in position and proportioned for the best vacuum attainable when the engine is working "heavy," that the same position cannot answer as well when the engine is working "light;" for, with a less quantity of steam, it is more easily condensed, and consequently a less quantity of water can only be drawn through the condenser. Mr. Morton has, however, made the starting-jet *movable*, and, as it is situated in the centre of the water nozzle, the water may, to some extent, be shut off by it; yet this does not appear to be taken advantage of, for, in the drawings from which our engraving was made, we do not find any means for *adjusting* the jet's position, although it is *movable*.

We believe, too, it is a well-ascertained fact, that, unless the water-jet completely fills the smaller diameters of the steam nozzles, the apparatus ceases to act, on account of the steam partly blowing the water into spray and partly escaping from the nozzles at a greater rate than the water; thus creating a pressure which reacts at a point beyond the nozzles, and opposes the issue of the jet; at least, this is the result of experience with injectors and ejectors, and as both these, as well as the ejector-condenser, are based on identical principles, the same consequence must follow in all alike. It may, however, be suggested that, when the water is partly shut off in Morton's apparatus, the smaller diameters of the steam nozzles are kept full on account of the water flowing at a slower rate when the engine is working "light." But, we ask, is it ascertained that it does flow slower? And here we would remark, that we believe, if the jet is by any means diminished in its velocity, the condenser must cease to act; for the continuous flow of the jet depends on the momentum imparted to it by the impulse of the steam condensed, and, if the velocity is diminished, so much less energy or work must there be in the jet. The momentum of the jet must, therefore, be maintained in some way, either by making up the full quantity of steam required, by live steam from the boiler, or by using an equivalent, either of a sufficient head of water, to maintain a sufficient rate of flow through the condenser when the engine is "working light" to ensure both the filling of the nozzles as well as the required momentum of jet, or by using a

FIG. 2.

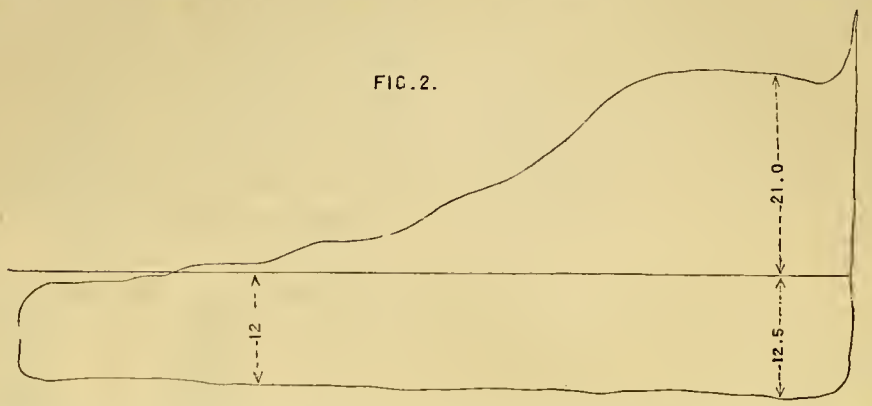



FIG. 3

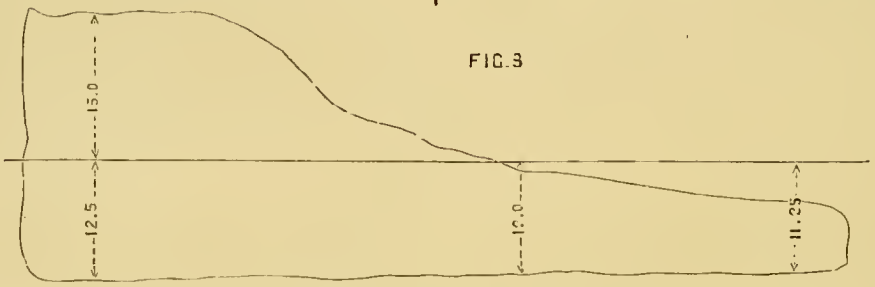
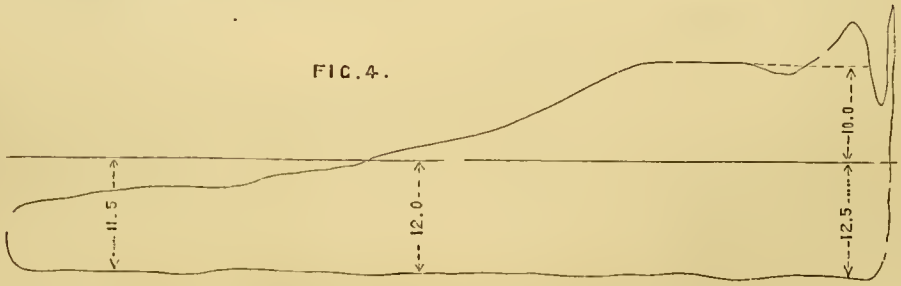



FIG. 4.



"tail-pipe" of sufficient length attached to the escaping end of the condenser, which, acting as the longer leg of a syphon, could pull the water through the condenser at the required rate. But the two latter of these can only be resorted to in exceptional cases, and of course, when either sufficient head or sufficient fall cannot be got, must we not conclude that the other—namely, live steam—must be adopted? The latter, with some other remarks in a foregoing article, constitute grave reasons why the professed economy of the ejector-condenser, arranged in the manner we have alluded to, must be viewed with suspicion on the part of engineers and steam-engine users. If we are wrong in our conclusions—and none will be more glad to find that we are in error than we ourselves shall be—let those in whose power it is to point out our errors, if they are such, do so in the same public manner as we have expressed our doubts; let them clear up the haze and mist that surrounds the whole affair, which, if they are able to do, should present no difficulty in doing. We only wish to make here one comment more, namely, if the nozzle in the centre of the condenser is merely a *starting-jet*, why is it provided with a *self-acting* valve on the steam-pipe communicating with the boiler? for if a "starting-jet" merely, it surely can only be needed when the condenser is *started* into operation, and in that case we should have thought it much better to have applied a cock or valve which could be opened or shut by the hand, and through which, when shut off, we might have felt sure that no steam was escaping.

We have examined Mr. Barclay's condenser in operation, and are able to testify that it does act without taking steam direct from the boiler. In the condenser which we examined in operation there was a pipe leading from the boiler to the condenser and provided with a stop-cock, in order that steam might be turned on to put the fluids in operation at the commencement of working in the manner as stated in Mr. Barclay's specification of 1864 and quoted by us last month at page 81; and further, after it was properly started we had the stop-cock closed so that steam did not pass from the boiler through the apparatus; hence we are in a position to say that we know the exhaust steam is sufficient to maintain the water of the ejector-condenser in operation when supplied with exactly adjustable nozzles and a receiving chamber or reservoir, as shown in our plate of Mr. Barclay's condensers last month.

Fig. 5.

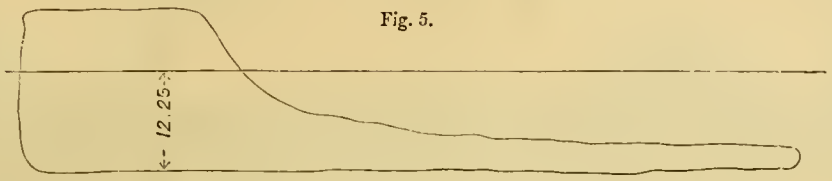



Fig. 5 is an indicator diagram from a pair of 9-inch cylinder horizontal engines fitted with Mr. Barclay's recently patented slide-valve—a valve (by the way of mere mention at this place) which cuts off the steam as rapidly as in the Corliss arrangement, and that without machinery; and whilst giving this diagram here only for the purpose of showing the vacuum formed with the ejector-condenser of Mr. Barclay, we cannot avoid drawing attention to the form of the expansion curve, which is, indeed, the closest approach to the theoretical expansion curve we have yet seen; close indeed as is the curve when formed by the Corliss valves in good order, this, indeed, is more perfect. We shall on a future occasion fully describe and illustrate the valves referred to, and which we may anticipate so far by stating that they are of the double-slide class.

Fig. 6.

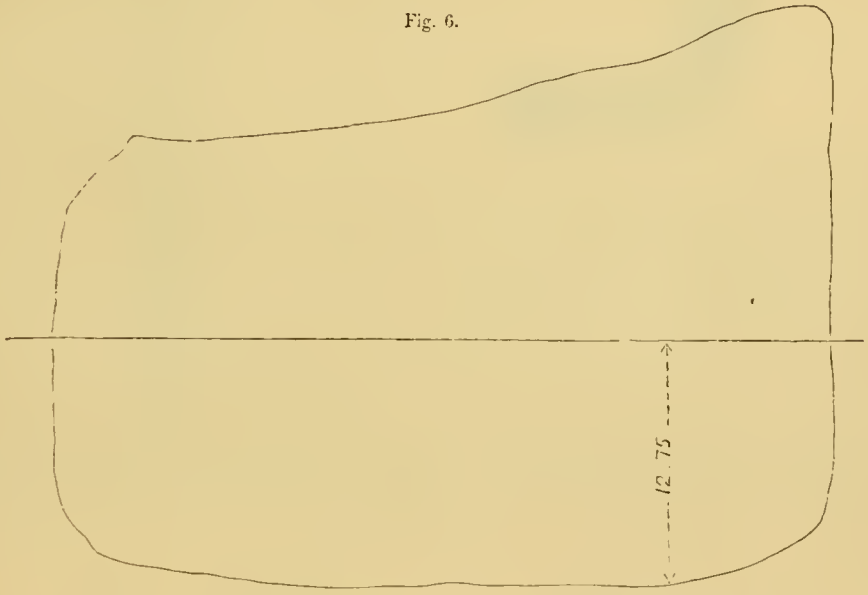
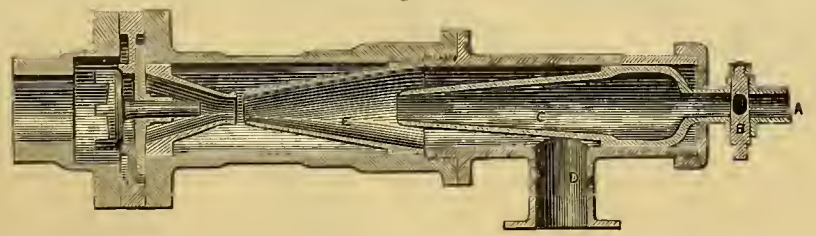
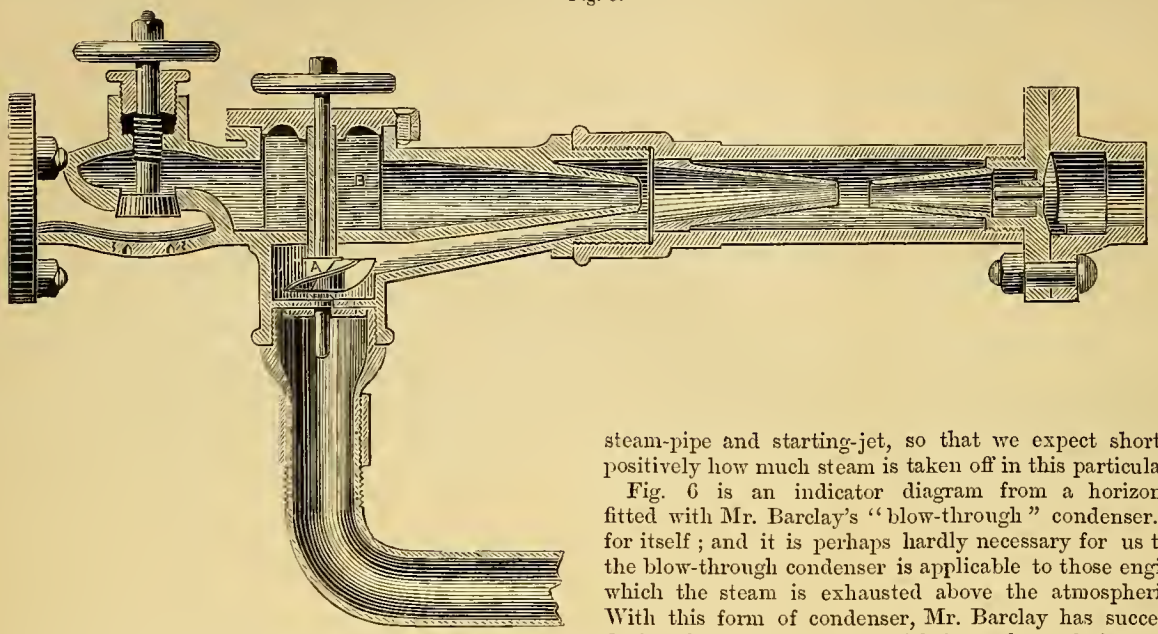



Fig. 7.



In Mr. Barclay's arrangement of the condenser, owing to the nozzles being more correctly formed and also being adjustable, the proper quantity of injection or condensing water only is admitted, and that is very much less than required for Morton's fixed nozzle modification, and less too than hitherto used by the in-

Fig. 8.



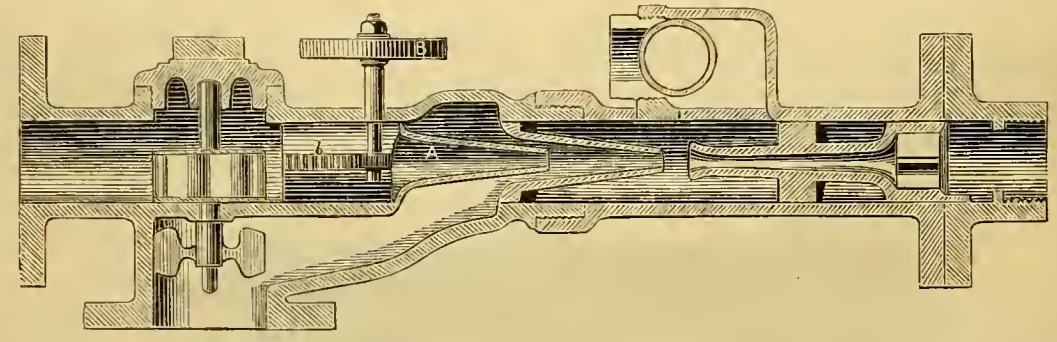

jection and surface condensers; so much less, in fact, that when the engines make 16 single strokes per minute, which (there being two cylinders) corresponds to 64 impulses of exhaust steam on the water-jet per minute, the water escapes from the instrument at an average temperature of 140° Fahrenheit—that is to say, it is heated to between 50° and 60° higher than it has yet been made known to have been effected by Mr. Morton; and we think engineers will not be slow to appreciate the importance of the fact we have now alluded to.

We may, perhaps, be accused of some partiality in the remarks of this paper; but our strict desire is only to elucidate the truth, and if we have erred in the least on either side, we need only add that our correspondence columns are open for either Mr. Barclay or Mr. Morton to correct or explain any point wherein either may deem us to have erred; wherefore, if no such explanation does reach us, it may be safely assumed that we have not misapprehended the state of the matters upon which we have now written at some length; and before passing on further we again repeat, that until the uncertainty attending the "starting-jet" in Morton's arrangement is cleared up, engineers cannot be in a position to form even a tolerable estimate of the economy of the apparatus. At this point a question arises, Is it possible to mechanically measure the quantity of steam, if any, that passes through the starting-jet? We reply, Yes, certainly; and for the information of some who are not in the position of knowing what is being done, we may add that we have within the last few weeks examined a steam meter specially designed for measuring the flow of steam from a boiler; and we are further informed in our correspondence that this steam meter is to be affixed to one of the ejector-condensers between the boiler steam-pipe and starting-jet, so that we expect shortly to know positively how much steam is taken off in this particular manner.

Fig. 6 is an indicator diagram from a horizontal engine, fitted with Mr. Barclay's "blow-through" condenser. It speaks for itself; and it is perhaps hardly necessary for us to add, that the blow-through condenser is applicable to those engines only in which the steam is exhausted above the atmospheric pressure. With this form of condenser, Mr. Barclay has succeeded in reducing the fuel of a boiler which formerly used eighteen wagons of coal per week to eleven wagons, so that no question can remain as to the economy to be effected in applying these condensers to ordinary high-pressure engines, and we should add that the feed-water is by means of it heated to about 150° Fahr.

We have now to turn to another department of our subject. At page 92 of the present volume of this Journal is a letter from Mr. Thomson, stating particulars of an injector made and used by him on the locomotive "Allanton," belonging to the Edinburgh and Glasgow Railway Company, in 1856, before the date, indeed, of Giffard's patent. In a note to the letter, the writer promised to illustrate the instrument alluded to, not on the ground of exhibiting a perfect injector, but for the purpose of showing the progress of modern thought and experiment in this branch of mechanical practice.

Fig. 9.

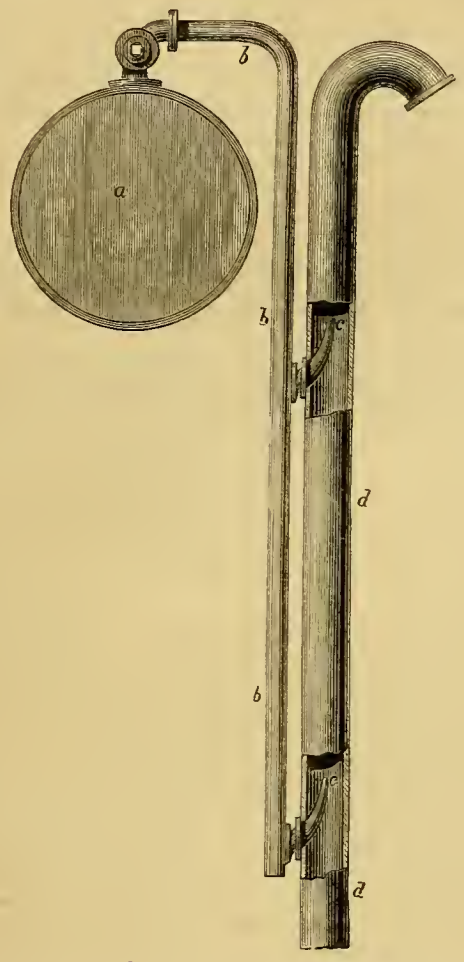



The injector, as fixed to the "Allanton," is shown in section at fig. 7.

In this instrument, Mr. Thomson informs us, the steam was admitted by the pipe A, which was provided with a stop-cock B; on issuing from the nozzle C it acted upon the water attracted into it through the branch D, which uniting in the converging throat E passed thence through the diverging throat into the boiler. Now, this experimental instrument corresponds in general arrangement to Giffard's injector; but it is clear from the woodcut, which has been drawn from the instrument itself, now in our hands, that

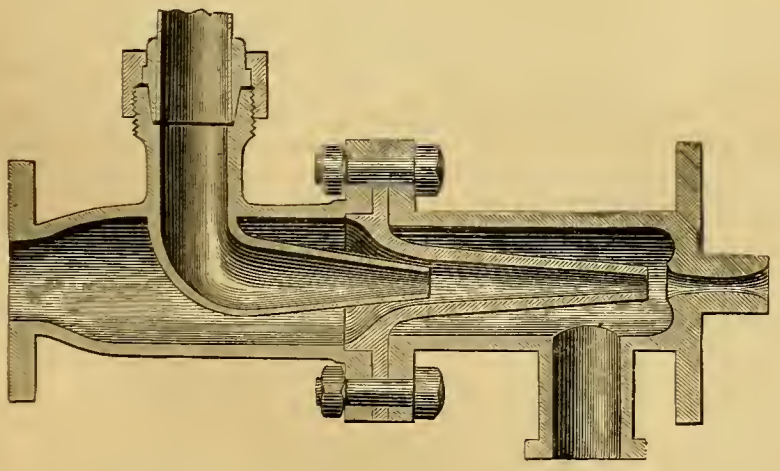
the proportions as well as distances apart of the nozzles were very far from what is now known to be requisite in the constitution of an efficient injector; hence it was found not to draw water well, and Mr. Thomson then added a small centrifugal pump to his injector,

Fig. 10.




as shown at A, fig. 8, fixed on to the spindle of a vane-wheel B, on which the steam acted and rotated before running into the steam-nozzle. This instrument was in use as a boiler-feeder at Aitkenstone Colliery, belonging to Messrs. Merry & Cunninghame, in 1861. Fig. 9 is another arrangement of Mr. Thomson's in-

Fig. 11.



jector, which was used as a boiler-feeder at Hawcrage Street Engine-Works, Airdrie, in 1863. In this instrument the steam-nozzle A was made adjustable, and it was regulated in position by means of the hand-wheel B actuating the pinion and rack *b* on the cylindrical body of the nozzle; similar, indeed, to Robinson & Graham's arrangement of 1864.

Fig. 10 is a sectional elevation of an apparatus also used at the Hawcrage Street Engine-Works, as a water-lifter, in 1863. The steam-jets were 4 ft. apart, with orifices of 5-10ths inch diameter, the water-pipe was an inch in diameter; with this apparatus, and steam at 30 lbs. pressure per square inch, 7·5 gallons of water were lifted 45 ft. high per minute.

In the course of writing these articles, various arrangements of injecting and ejecting apparatus have at different times come under our notice, and which have necessarily not been included in their place as to class, amongst which we may mention a perfect fasciculus of proposals by Mr. James Robertson, of frictional-gearing notoriety, the patent for which embodies no less than 15 sheets of drawings. We shall on a future occasion add another article, embodying whichever of these are of sufficient importance to place on record; and in concluding the present article, we must refer to the injector of M. Schau, of Vienna, illustrated at fig. 11, and which is largely used on the Continent. V. D.

*(To be continued.)*

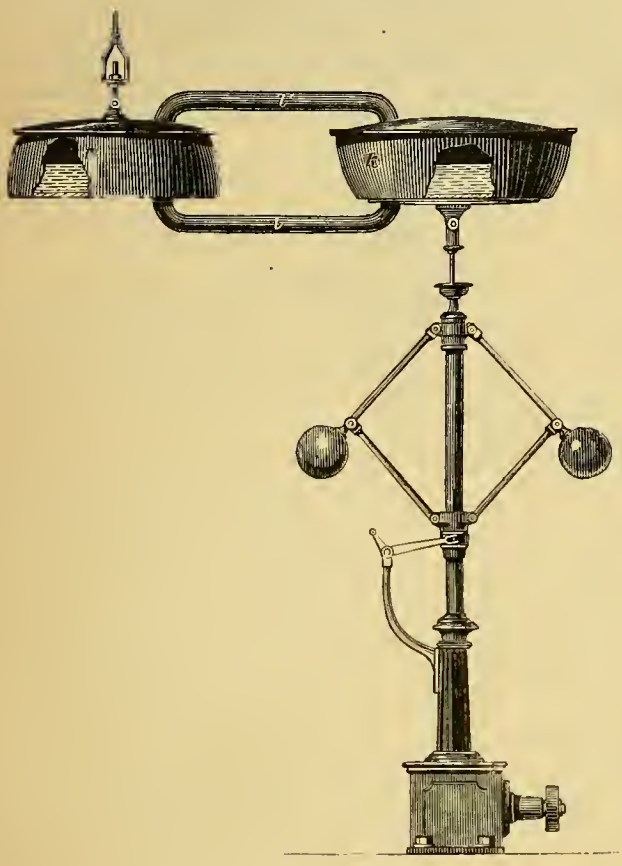
## KESSELMEYER AND NACKE'S PATENT FLUID DIFFERENTIAL GOVERNOR.

THE improved governor represented by Plate VIII., and by the accompanying wood-engraving, is the invention of Messrs. William Johannes Kesselmeyer and Charles Augustus Kesselmeyer, of Manchester, and Emil Hermann Nacke, of Alt Schöncfeld, in Saxony, for which they have obtained Letters-Patent, dated 22nd August 1868 (No. 2,615).

The object of this invention is to render centrifugal governors more perfect than heretofore in regulating the speed of the engine. For this purpose, the patentees connect a vessel or vessels containing mercury or other fluid to a movable part of the governor, and there is also another vessel or vessels containing fluid communicating with that or those first mentioned. As the balls rise or fall, the fluid passes from one vessel to another until a common level is attained, and the balls, therefore, become less or more loaded. The vessels which contain the fluid have curved interior surfaces, whereby the quantity of fluid is in proportion to every position of the balls. The arrangements shown in the plate, and in the wood engraving, are adapted for the use of water; when mercury is employed, much smaller vessels are made use of. In fig. 1 of the plate, A A represent the governor balls mounted on the usual levers B B, being connected to the sliding collar C by the links D D. The driving spindle is at E, formed hollow, and contains a rod F, which rests in a footstep formed in a cross-bar G, carried by the sliding collar C, and passes through a slot in the hollow spindle E. I is the lever which communicates motion to the ordinary throttle or other valve. Upon the upper end of the rod F is a vessel K containing water or other fluid, and within this vessel is one leg of a syphon, or pipe L, the other leg thereof being situate in the fluid contained in a stationary vessel M, which is supported on a pedestal or column N placed on the ground or floor of the engine-house. As the balls A A fly out or collapse, the sliding collar C will, by means of the cross-bar G, carry upward the rod F, or allow it to fall, and the vessel K will, therefore, move upwards or downwards. Supposing the balls to fly outwards, the vessel K will rise with them, and part of the contained fluid will flow through the syphon L into the stationary vessel M until a common level exists in both vessels. Therefore, just in proportion as the balls A A rise, the fluid in the movable vessel K will decrease, and, consequently, the weight pressing upon the balls A A by means of the rod F, will decrease the same in proportion. The reverse will be the case when the balls collapse and sink, for then the rod F and movable vessel K will move downward, and therefore a portion of the fluid in the stationary vessel M will flow through the syphon L into the movable vessel K, and the balls, therefore, will become weighted by the additional fluid, and in proportion to their collapsed position. By means of

this arrangement the governor is enabled to regulate immediately the speed of the engine as soon as it shall vary, and maintain it at a uniform speed, or nearly so, however much or little it may be loaded. The syphon is either attached to the stationary vessel M, or suspended from the roof of the building, in order to prevent the weighting of the movable vessel K on one side; and care must be taken that it does not touch the bottom of the vessel when it rises, for which purpose an elongation in the bottom of the movable vessel is formed as shown in fig. 1. The precise regulation of the quantity of fluid passing from one vessel to another is effected in a

Fig. 1.



very ingenious and practical manner by forming the interior of the vessels in curves, so as to give them a longer horizontal section in those places where a larger quantity of fluid is required to flow from one vessel to the other. Or, by another method, the inventors place a solid body in the vessel, and which is formed of various diameters, as fully explained in their specification.

The arrangement shown at fig. 2 of the plate is very similar to that of fig. 1, in so far as the vessels M K are concerned. In this arrangement, however, the stationary vessel M is suspended by a rod N from the roof of the building. Both vessels are air-tight, and are therefore provided with two communicating pipes or tubes, one L for the water, the other O for the air. It will be seen that in the arrangement shown in fig. 2 the air-pipe or tube is attached to the lower part of the vessel, and extends upward above the fluid when at its highest level. The wood engraving represents another arrangement of this improved governor; *m k* are the two vessels, the former being suspended as shown, and the two are connected together for the passage of the fluid by the pipe *l* and by another tube *l'* for the passage of air. It is only necessary to remark in conclusion that the arrangement of governor shown at fig. 2 of the plate has been put into operation at Leipsic in Saxony, and has proved eminently successful, the accuracy of its mechanical working being all that can be desired, and the cost of the apparatus inconsiderable.

## ON THE RECENT DISCOVERY OF PHOSPHORITES IN THE LAHN AND DILL BASINS, WESTPHALIA.

The scientific agriculturist has for nearly thirty years been anxiously looking for cheaper and more copious sources of supply of phosphorus as a manure than those coming in the shape of bones, whether fossil or recent, from the animal world. Coprolites, now probably ascertained to have been so named through mistake as to their origin—being, in fact, portions of rounded and worn fossil bone of peculiar organisation—have so far, however, presented the chief available source, in addition to that of recent bone or bone manure in whatever state of preparation.

Estramadurite, the phosphorite of Spain, which exists in vast abundance, but unfortunately in a locality very difficult of access, though examined by Dr. Daubeny of Oxford long since and reported on as presenting an inexhaustible source of phosphorus, has so far proved sterile, partly from the reason above given, partly from difficulties presumed to have existed as to any feasible mode of extracting the phosphorus in any soluble or usable shape for agriculture.

We believe the latter part of the problem presents no longer any theoretic difficulty at least, and that chemical manufacture might be enriched by the formation of a new branch of trade as soon as an abundant and certain supply of the raw material could be ensured.

It is, therefore, with great interest that deposits of phosphorite have been ascertained to exist, very widely diffused over a large area in a most accessible part of Germany, one everywhere commanded by railway and by the navigable streams which are tributaries to the Rhine.

A large pamphlet, accompanied by an excellent map, has been published lately at Berlin, in which Mr. C. A. Stein, Royal Mine Director of Wiesbaden, has given a complete account of the occurrence of this, to be hereafter valuable, mineral in the above regions.

It was not known before the year 1864 that the lands bordering the rivers Lahn and Dill were rich in phosphorites, with a high percentage of phosphate of lime ($3\,Ca\,O + P\,O^5$); and, notwithstanding the discovery of this material in different localities at a much earlier date, it was not before the above year that phosphorites in immense quantities were first met with in the district (gemarkung) of Staffel and Limburg. The first analysis of this phosphorite was made in July 1864, and showed 67·8 per cent. of phosphate of lime, and not long after several enterprising firms undertook the practical working of this discovery. Since 1864, however, phosphorites have been discovered in large quantities in the districts of Hinterland, Wetzlar, Dill, Oberlahn, and Unterlahn, in which diggings have commenced at about fifty different places.

With respect to mineralogical characteristics, these phosphorites differ very much from those described in mineralogical works, so that this mineral seems to have been known previously only in a few of its modifications. The fibrous structure, formerly attributed to phosphorites as varieties of apatite, is not to be found in these minerals, in which a solid amorphous constitution of a brownish yellow or light fawn grey colour, and showing a splintery fracture are predominant characters. With respect to hardness, friable and soft varieties are distinguished as another characteristic, especially in cases where, on account of the immense mass of the mineral found, the material can only be got out by means of blasting. The specific gravity of some specimens of a brownish-yellow colour averages=2·9, and of which the following analysis has been given by Fresenius:—

| | |
|---|---|
| Lime | 45·79 per cent. |
| Magnesia | 0·16 „ |
| Oxide of iron | 6·42 „ |
| Alumina | 1·08 „ |
| Potass | 0·58 „ |
| Soda | 0·42 „ |
| Phosphoric acid | 34·48 „ |
| Carbonic acid | 1·51 „ |
| Silicic acid | 4·83 „ |
| Fluoric acid | 3·45 „ |
| Water | 2·45 „ |
| | 101·17 per cent. |
| Less 1 equivalent of oxygen for 1 eq. of flour | 1·45 |
| | 99·72 per cent. |

With traces of manganese, iodine, and chlorine.

It is interesting to compare, with the analysis above given, that of other phosphorites, for instance, that of the Amberger phosphorites found in the Jura limestones, of which Schröder gives the following analysis :—

| | |
|---|---|
| Lime | 48·16 per cent. |
| Phosphoric acid | 42·00 „ |
| Alumina | 4·97 „ |
| Oxide of iron | 1·56 „ |
| Magnesia (Bittererde) | 0·75 „ |
| Potass | 0 04 „ |
| Soda | 0·02 „ |
| Carbonic acid | 2·21 „ |
| Water | 1·31 „ |
| | 101·02 per cent. |

The incrustations which generally cover the solid phosphorites are very characteristic in leading to the discovery of the product, and have a decided influence upon the mineralogical characters and external forms of the masses. Most of these masses are opaque, but a few, and especially those of a greenish tint, are decidedly pellucid, some in mass, others in splinters. The incrustations must be considered as a homogeneous mineral formation, the hardness of which as given by Stein is 4, and which represent an entirely new mineral species. Dr. Forster, in Fresenius' laboratory, in 1865, made the following analysis of a green pellucid mineral incrusting the phosphorite from the district of Staffel :—

Specific gravity: 3·1284.

| | |
|---|---|
| Lime | 54· 67 per cent. |
| Oxide of iron | 0·037 „ |
| Alumina | 0·026 „ |
| Phosphoric acid | 39· 05 „ |
| Carbonic acid | 3· 19 „ |
| Fluoric acid | 3· 05 „ |
| Water | 1· 40 „ |
| | 101·423 per cent. |
| Less 1 equivalent of oxygen for 1 eq. of fluor. | 1·280 |
| | 100·143 per cent. |

Combining the acids and the bases, the following composition of the mineral is obtained :—

| | |
|---|---|
| Basic phosphate of lime | 85·10 per cent. |
| Phosphate of oxide of iron | 0·07 „ |
| Phosphate of alumina | 0·06 „ |
| Carbonate of lime | 7·25 „ |
| Fluoride of calcium | 6·26 „ |
| Water | 1·40 „ |
| | 100·14 per cent. |

Stein, with the sanction of Fresenius, the celebrated analyst, named this as a new mineral "Staffelite" after the name of the district where it had first been found. Dr. Petersen of Frankfort, from his analysis of other specimens, deduces the mineralogical formula—

$$3\,(\dot{Ca}_3\,\dddot{P}) + Ca\,Fl + Ca\,\ddot{C} + H.$$

The country in which these minerals are widely spread is one of great geological complexity. The phosphorite generally lies in diabase and shale, overlapped or underlaid by lower and middle Devonian and by diluvial beds. The whole region is full of seams, beds, and veins of black, red, and brown hematites. There is little doubt that but a small proportion of these phosphatic deposits has yet been discovered; and indeed the writer of this notice, from personal examination, having wholly different objects in view, is tolerably certain that like deposits occur in other portions of the right Rhine basin much further north.—Ed.

## ON COMBINING CAST IRON WITH WOLFRAM—UPON THE GREAT SCALE.

In the *Comptes Rendú*, tom. lxiii., as well as in "Dingler's Polytechnick Journal," B. 183, for 1867, notices will be found of the process of M. Le Guen for combining these metals in the cupola, which may prove important in the event of any really valuable properties being developed by its combination with wolfram. The reduced wolfram, producing after its separation from the ores a powder, is found difficult to melt together with other metals unless in an air furnace, even in which large quantities of the wolfram get lost, or in crucibles, which would be found too expensive for the purpose. The method of M. Le Guen consists in producing agglomerations or lumps, which resist breaking up in the fire sufficiently, though without preventing the combination of both metals. For this purpose dry caustic lime, which must be carefully protected against moisture, is mixed with the reduced wolfram; a certain quantity of this powder is kneaded into intimate mixture with hot vegetable tar, or coal-tar, so as to form a homogeneous dough, which, if necessary, is heated or baked, and then saturated with more tar, till it becomes so coherent that it may be divided into *briquettes* of any size. Those made for the experiments of M. Le Guen were about the size of a fist. The cupola furnace is charged with alternate layers of the substances which have to be melted together. After the bottom has been filled with coke, &c. as usual, a layer of briquettes is put in next, which must be covered with some coke in order to protect the wolfram better against oxydation; next comes a layer of pig-iron and of hard-burnt (*zuschlagskalk*) lime —of the latter, however, less than usually, on account of the pre-existing lime in the briquettes—and then again a layer of coke, and so on. This arrangement is to be continued till the cupola is completely charged. The charging may also go on whilst the furnace is at work, in which case it will be sufficient to charge the materials iu the same succession through the mouth. M. Le Guen says that the blast must be shut off during this charging, but it does not seem necessary. After tapping, the metal runs first into ladles, in which it is stirred up, in order to get it more homogeneous before it is poured into the moulds. M. Le Guen has applied this process in the foundry of the dockyard of the port of Brest, in the year 1866; he used chiefly coal-tar for the manufacture of the briquettes. The cupola was charged in the manner above mentioned, both in the cold and in the hot state. The cupola employed had a clear diameter of 0·76 meters, and a height from the bottom to the mouth of 2·80 meters. Each of the charges, *i.e.* each layer it is to be presumed, of pig iron weighed 100 kilogr. Analyses, carried out at the "*École des Mines*" at Paris, have proved that, by this method, M. Le Guen has been successful in combining the greatest part of the wolfram with the cast iron. The cast iron, which he obtained by charging into the hot cupola, and to which charge he had added the largest quantity of reduced wolfram (15·375 kilogr. to 100 kilogr.) contained in 100 kilogr. on the average 8·84 kilogr. of wolfram. The latter modification of the process may, therefore, be applied with advantage to combine cast iron with even a larger quantity of wolfram. We have as yet no information as to the physical properties of the alloy.

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## RECENT PATENTS.

### FLYERS FOR SPINNING OR TWISTING COTTON.

John Henry Johnson, 47 *Lincoln's Inn Fields; a Communication from* John Whitin, *Whitinsville, Massachusetts, U.S.A.*—*Patent dated October* 7, 1868.

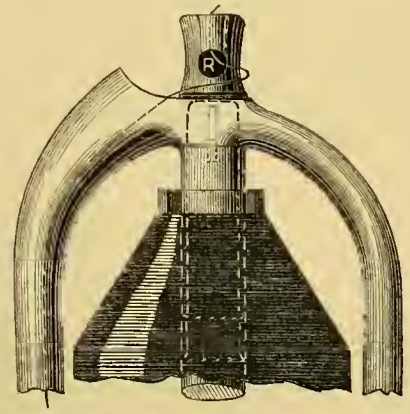
These improvements have reference, firstly, to the flyers for fly frames, or any frames where the flyers are removed for doffing, and consist in providing a curved tube or passage for the roving, through the upper part of the flyer, distinct from the socket by which the flyer is fitted on to the upper end of the spindle. By this mode of construction the operation of passing the end of the roving through the opening is greatly facilitated; and as the access of fluff, or lint, and dirt to the socket proper is completely prevented, all danger of the flyer becoming loose or running out of balance is avoided. The second part of the invention relates to centrifugal pressers for presser-flyers, and has for its object the affording facility for readily reversing and replacing the presser-arm when requisite. According to this part of the invention, it is proposed to connect the arm of the flyer and the detachable presser by a special guide and worm, situate either at the lower or upper portion of the flyer-arm, so that when turning one way the presser tends to detach itself from the flyer, and when turning in the opposite direction it stops, by the fact of the presser-arm itself coming in contact with the end of the flyer-arm. In the improved arrangement, moreover, the presser-arm is below the opening in the flyer-arm, whereby the passage for the roving to the presser-arm is rendered more uniform, or equal and direct, than in any other flyer.

Fig. 1 of the engravings is a section through the nose or upper part of the improved flyer, as constructed in accordance with the first part of this invention; and fig. 2 is a sectional elevation of the improved flyer, showing also parts of a spindle and filled bobbin.

In figs. 1 and 2, R represents the improved continuous passage

Fig. 1.

Fig. 2.




for the roving, and which is constructed as follows:—A piece of brass tubing is bent to the required form, and after being placed in the desired position, is secured firmly at the ends; but the curved passage may be obtained by casting it in composition or other metal, or, where malleable iron flyers are used, the curved passage can be cored out in casting. Fig. 3 is a side elevation of a flyer and presser, with the presser detached, for speeders and like machines constructed according to the second part of this invention. Fig. 4 is an edge view of the flyer and presser, the bobbin not being shown. Fig 5 is a view of the presser detached from the flyer.

The ordinary flyers of speeders and fly frames are made so that the pressers are forced against the bobbins by springs; or by the centrifugal force produced by the speed of the flyers, or by gravity —the weight of the pressers on an inclined plane causing the presser to press against the bobbin. The spring flyer is objectionable, because the operator in piecing is obliged to use one hand in holding back the presser, when it is desirable to use both hands in the operation of piecing. The centrifugal and other flyers heretofore used, where the gravity of the presser in connection with an inclined plane is made available, are either permanently secured to the flyer, or are so made that when the presser is moved back further than is needed in doffing, it is likely to pass over the apex of the incline, and thereby cause delay.

In order to remedy these defects, and to make flyers with pressers that are easily *detached*, and that have their arms below the opening in the flyer-arm, to ensure a more sightly form, to effect

Fig. 3.

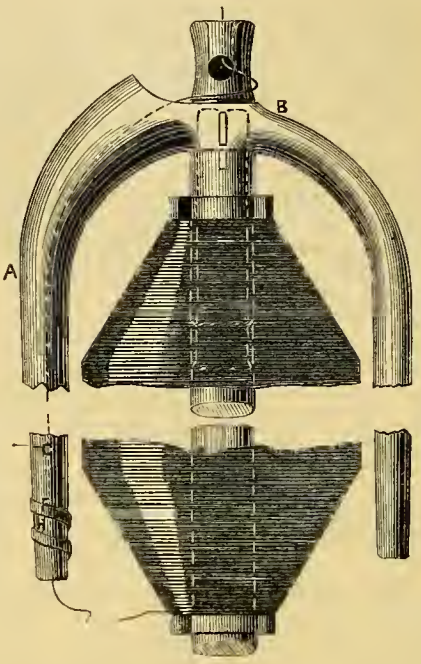
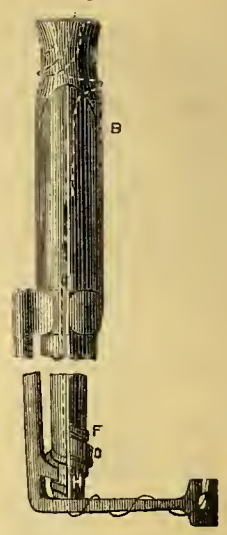


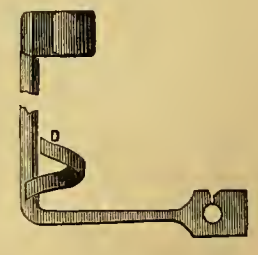

Fig. 4.




economy in construction, and to render the flyers more effectual in operation and more convenient for repairs, are the main objects of this part of the invention.

B, figs. 3 and 4, shows a flyer made as they often are, except that on the arm C is formed a spiral groove H, in which the worm D on the presser (figs. 4 and 5) is made to slide, so that when the presser-arm brings up against the bottom of the flyers, it stops; and when turned the other way detaches itself from the flyer when there is no bobbin or spindle for it to press against. These flyers are so made that any presser will fit any flyer of the size to which it is adapted; and when a presser is broken or worn out, any operative can renew it, without calling upon a machinist. The spiral F may be brazed upon the arm, or, if of malleable metal, it may be cast on; but it is preferred to forge that part of the arm for the spiral groove thicker, and, after the thin flat iron of the arm C is bent up into the rounded form, the spiral groove is cut by means of a revolving cutter. The worm may be at the upper end, but it is lighter and neater when placed at the bottom.

Fig. 5.



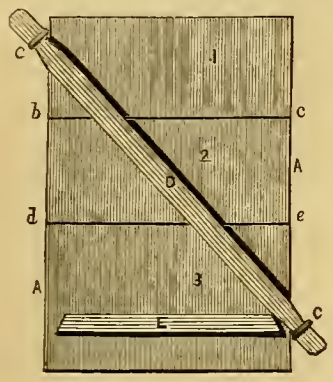

This flyer and presser can be disconnected without the use of tools, any presser being made to fit any flyer of corresponding size; and the two parts can be immediately connected with each other, The convenience of this readiness in *detaching* and *connecting* is obvious in case of breakage, or renewing the pressers for any cause.

## INVOICE-HOLDERS.

WILLOUGHBY MONTGOMERY MOORE, *Balscadden, Howth, Dublin.—Patent dated August* 6, 1868.

THIS invention relates to a simple and economical construction of holder for containing invoices, letters, and other documents in such a manner as to afford facility for the inspection of any portion of any of the documents when required, without necessitating their removal from the holder. Fig. 1 of the accompanying engravings shows the holder closed, and fig. 2 is a perspective view of the same, with the upper and lower portions opened out so as to expose the

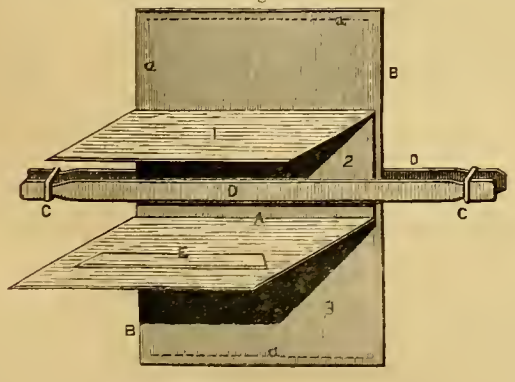
Fig. 1.




upper and lower extremities of the documents behind the board. The papers are held between the two boards A B of wood, cardboard, or other suitable material, the upper board being divided by a flexible hinged joint or joints into two or more parts, so as to enable more or less of the said board to fold back or open, and consequently expose more or less of the surface of the documents (indicated by the dotted lines *a a*) contained between such boards. The two boards are held firmly, but elastically, together, by being nipped between a pair of laths or strips of wood D, or other suitable stout material, such laths being held together by india-rubber or other suitable springs C applied to their extremities. A ridge or projection E is formed near one edge of both the boards to prevent the laths from being accidentally disengaged from or slipped entirely off the boards. When these laths are brought into a diagonal position, so as to pass across the joint or joints in one of the boards, the entire surface of that board will be maintained flat against the documents, effectually covering or protecting them, and securing them in their places; but by moving the laths along the boards so as to leave one or other of the joints free, then the corresponding part or parts of the jointed board may be folded or turned down so as to expose any desired portion of the document, or (if the document is provided with a wide margin) to expose the whole of the writing on one side, the margin alone being concealed and held between the boards.

If desired, the usual appliances for hanging or suspending the

Fig. 2.




invoice-holders from nails may be adapted to the back board, but if intended to lie on the table or desk the suspending loop may be dispensed with. With a view to affording ready access either to the upper or lower portion of the document, the front board A is free to fold along the line *b c*, which enables either the upper part 1 to be turned down, thereby exposing fully the upper half of the invoice, or the lower part 3 of the said board to be turned up with a view to exposing the lower half of the documents contained between the boards without, in either case, releasing the grip or hold upon the papers, it being simply necessary to slide the laths D over the lower or upper half (as the case may be) of the folding board A.

## PERMANENT WAY OF RAILWAYS.

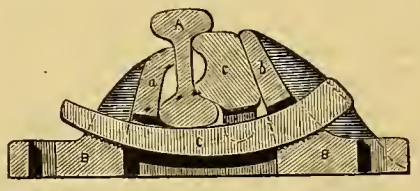
JOHN HENRY JOHNSON, 47 *Lincoln's Inn Fields; a Communication from* RUSSELL AITKEN, *Bombay.—Patent dated September* 26, 1868.

THESE improvements relate, firstly, to a method of securing the ordinary double-headed rails in chairs, whereby the usual wooden-key is dispensed with, and the bottom of the rail is protected from injury.

Secondly, to a mode of constructing an iron permanent way which shall be as nearly as possible uniformly elastic.

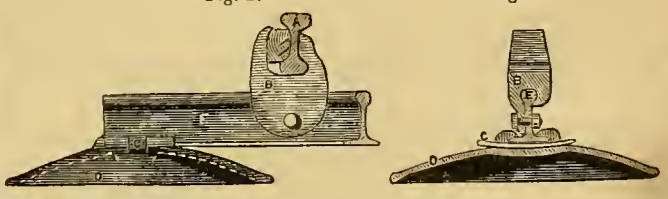
Fig. 1 of the accompanying engravings represents the mode of securing ordinary double-headed rails, which constitutes the first part of the invention. A is the rail and B the chair, which may be secured in any convenient manner on to a wooden or other sleeper. C is an iron or steel wedge, which may be curved or bent as shown, driven underneath and at right angles, or transversely to the rail, suitable openings being made in the lower part of the jaws *a b* of the chair for that purpose. By this means the rail is forced upwards and consequently jammed tightly against a filling-piece *c*,

Fig. 1.




which is inserted between one side of the rail and the jaw *b* of the chair. As the inner faces of the two jaws *a b* are inclined inwards slightly towards the top, and as the back of the filling-piece *c* is also inclined to correspond to the inclination of the jaw *b*, it follows that, on driving in the metal wedge or key C, the rail will be tightened in the chair. The filling-piece *c* may be of cast-iron having slightly projecting holding surfaces at its upper and lower edges, on the side next the rail, so as to nip the rail close to its top and bottom heads. A groove or notch may also be formed across the filling-piece for the passage of the key or wedge C, a part of the filling-piece being thus made to project downwards on either side of the key or wedge, by which arrangement the filling-piece is prevented from being shaken out of its place. The wedge or key C need not bear upon the chair directly underneath the rail, but it is preferred that it shall be supported at a certain distance on each side of the rail, as shown in fig. 1, as thereby a certain amount of elasticity is secured. The liability of the wedge or key to shake out of its place or become loosened is obviated more or less by making those parts of the chair upon which it rests serrated or rough, as shown in fig. 1; or, if preferred, the thin end of the wedge may be slightly bent over or otherwise secured in place.

Fig. 2. Fig. 3.




Figs. 2 and 3 illustrate the mode of constructing an iron permanent way according to the second part of the said invention. A A are the rails and B B the chairs, which may hold the rails either in the ordinary manner as shown in figs. 2 and 3, or they may be shaped and made to hold the rails in the manner shown in fig. 1; but whatever may be their construction and mode of

gripping or holding the rail, they are to be so situate as not to rest directly upon or over, or form part of the cast-iron bowl or other sleeper D, but are carried by and secured to cross girders E by bolts, rivets, or otherwise. The cross girders E rest at their ends on the cast-iron bowl sleepers D, or upon sleepers of any other material or shape, or upon wrought-iron buckled plates. They may be secured to such sleepers by riveting, or by projecting lugs or otherwise. In fig. 3 the girder is represented as being secured to the sleeper by a transverse curved wedge or key C driven underneath the girder, and tightening it in its place in a similar manner to the rail as described in reference to fig. 1.

The object of this construction of permanent way is the obtainment of any desired amount of elasticity. The cross girders E, at the points where they carry the rails, yield as the wheels of the engine or carriages pass over them, and the required amount of elasticity is secured by proportioning the strength of the cross girders to the distance between the point where the rail is secured to it and the part of the girder which rests upon the sleeper.

## LAW REPORTS.

PLAITED TRIMMINGS.—WIGHT *v.* HITCHCOCK.—Court of Exchequer, before the Lord Chief Baron and a special jury, June 19, 1869. This was an action for an alleged infringement of a patent obtained by Mr. James Willcox of the Willcox and Gibbs Sewing Machine Company, for "Improvements in the Manufacture of Frills or Ruffles, and in the machinery or apparatus employed therein," being a communication from abroad by Mr. Croshey, of the United States. This patent was dated the 19th February 1862, and was subsequently assigned to the plaintiff. The alleged infringement consisted in the sale by Messrs. Hitchcock and Williams, of St. Paul's Churchyard, of frills or plaits made by Mr. James Orr, of Glasgow, by a machine for which he obtained a patent in 1867.

Mr. Grove, Q.C., Mr. Webster, Q.C., and Mr. T. Aston (instructed by Mr. J. H. Johnson, of 47 Lincoln's Inn Fields), appeared for the plaintiff; and Mr. Manisty, Q.C., and Mr. Macrory (instructed by Mr. J. N. Mason, of Gresham Street), were for the defendant.

The invention of Mr. Crosbey relates to a peculiar manufacture of frills, ruffles, or trimminge, and to a peculiar combination of mechanism to be applied to a sewing machine for producing the same. The essential peculiarity is, that the folds or plaits are crimped in one direction and transversely to the cloth in a perfectly even and regular manner, and secured by stitches in lieu of the fabric being puckered or gathered in the ordinary manner.

The peculiar combination of machinery or apparatus, as adapted to an ordinary sewing machine, consisted of a reciprocating knife, having a straight or serrated edge, and provided with suitable notches on its edge for the passage of the needle or needles. Provision should be also made on the edge of this knife by cutting away portions thereof to allow for the increased thickness of the fabric at the hems or selvages. This knife rests upon the fabric to be crimped, which fabric rests upon a hardened and perfectly level steel plate let into the bed plate or table of the machine. This steel plate is provided with needle holes and apertures for the feeder to work through, such feeder being by preference the four-motion feed slightly modified in shape, so as to enable it to act upon the entire width of the fabric at different points simultaneously through the apertures above referred to. The forward edge of the presser foot is bevilled underneath to an angle of about 45°, and is notched at that part to allow the needle or needles to work through. In order to allow of the free passage of the hems or selvages, which are of course thicker than the rest of the fabric, the two outer edges or sides of the presser foot are made elastic, so as to yield independently of the main or central portion of the foot. A tooth or claw is formed on the under side of these yielding portions to retain the hem or selvage after it has been pushed under them by the action of the reciprocating knife. The knife is held down upon the fabric by a yielding pressure, such pressure being removed during the backward stroke of the knife. The forward stroke causes the fabric to be raised in the form of a fold, which fold is turned down over the edge of the knife by being pressed under the bevilled edge of the presser foot. The needle or needles now descend and secure the fold so made, for which purpose a hook, looper, shuttle, or other suitable contrivance may be used in combination with the needle or needles so as to perfect the stitch. The feed motion now comes into operation so as to move the entire fabric along in readiness for the next stitch, the crimping knife moving simultaneously in the same direction. The feed and knife then return to their original positions, and a fresh fold or plait is formed in the same manner, and so on. Suitable cams and adjustable levers are employed for imparting the reciprocating motion to the knife, and also for imparting the necessary pressure thereon. When two fabrics are used the one intended to form the plain band is passed over the knife and under the presser foot.

The specification claimed, first, the general construction, arrangement, and combination of machinery, apparatus, or means of producing crimped or plaited frills or trimmings in a sewing machine as before described; secondly, the application and use of a reciprocating knife for crimping fabrics in a sewing machine; and thirdly, the peculiar manufacture of crimped or plaited frills or trimming as described and illustrated by a figure of the drawings to the specification.

Mr. Orr's patent was for "Improvements in doubling, folding, or plaiting woven or other web fabrics, and in the machinery or apparatus employed therein or connected therewith." In his machine for the steel-plate, feeder and presser foot, two rollers were substituted, between which the fabric passes and the reciprocating knife acts, and there was no sewing apparatus, the plaits being afterwards sewn by an ordinary sewing machine. Mr. Orr claimed "the adaptation and use of a reciprocating folder or knife upon a roller or an equivalent surface, for the purpose of folding or plaiting fabrics up towards a feeding roller or rollers, or equivalent removing surface or surfaces, in which both the folder and the feeding surfaces are actuated in sequential time alternately from the same revolving or oscillating shaft."

On behalf of the plaintiff it was contended that the reciprocating knife was the essence of both Mr. Willcox's and Mr. Orr's machines, that the steel plate with feeder and the presser foot in the one case, and the two rollers in the other were mechanical equivalents, and that the knife being a new and material part of Willcox's combination, the use of this, even separate from a sewing machine, would be an infringement of the patent. When Mr. Grove had concluded, Mr. Manisty was requested by the Lord Chief Baron to state shortly the points on which the defendant would rely; he maintained that the goods sold by the defendant were a well-known article called plaited trimmings; that as regarded the defendants, who were mere sellers of them, it was immaterial whether Orr's machine were or not an infringement of the plaintiff's patent; and, further, that the article itself, having been made and sold prior to 1862, the claim to it in the plaintiff's patent would have the effect of invalidating that patent.

Mr. Willcox and Mr. Mallet, C.E., were called on behalf of the plaintiff to prove the novelty of the patent, its substantial identity with that of Mr. Orr, and the value of the invention of the knife, irrespectively of its connection with the sewing machine. Mr. Mallet maintained that though goods apparently similar have been made by hand, they have been very inferior, and readily distinguishable from those made by the plaintiff's or Mr. Orr's machine. The Lord Chief Baron at this point expressed his opinion that there was no question of fact at issue, Mr. Manisty having already admitted that the goods sold by the defendant were made by Mr. Orr's machine, but Mr. Manisty wished to go to the jury upon the question which he had raised. Mr. Grove then called Mr. Smith, a dealer in plaited materials, who stated that he had never seen such plaited goods as those produced previously to 1862.

His Lordship then again requested Mr. Manisty to state what his objections were, that he might decide whether they should be overruled at once, or leave should be given to the defendant to move upon them. Mr. Manisty then stated his objections to be three: first, that the plaintiff's patent was merely for a ruffle or frill, and not for a plaited trimming of any kind, except incidentally and in connection with the other; secondly, that the mere sale of a patented article did not constitute an infringement of the patent; and thirdly, that the third claim invalidated the patent, as the article claimed was a subject rather for a copyright than a patent. His Lordship consented to reserve these points, though he did not think that any argument could be raised on the third of them. Mr. Manisty then addressed the jury on the novelty of the peculiar manufacture of plaited trimminge claimed by the plaintiff, and called a Mr. Brook, manager to Messrs. Tillie & Henderson, who proved that plaits made by hand were made previously to 1862, for shirt fronts, but not sold in lengths as the plaintiff's were. His Lordship then left the question to the jury, whether Crosbey's invention was new in 1862, and as to whether the making of such goods by Orr's machine was an infringment of the plaintiff's patent. These questions were at once answered in the affirmative, and a nominal verdict for 40s. was found for the plaintiff, leave being reserved to the defendant to move on the points mentioned by Mr. Manistry.

SOCKETS FOR WHIP HANDLES.—HEWETT *v.* COOPER.—Court of Chancery, before Vice-Chancellor Sir W. M. James, July 8th, 1869. Mr. Fellows appeared for the plaintiff; Mr. Kay, Q.C., and Mr. Waller, for the defendant.

This was a motion on the part of the plaintiff, for an injunction restraining the defendant from infringing a patent, granted to the plaintiff in 1860, for sockets for whip handles, the main feature of the invention being that the plaintiff inserts in the socket a steel spring covered with leather, which clips or catches the whip handle. The defendant had sworn that the sockets made by him differed from the plaintiff's invention in that they were lined with leather and gutta-percha, and had no spring; but during the hearing of the motion one of the defendant's sockets was cut open, and it appearing that there was whalebone inside the leather, the Vice-Chancellor thought the affidavit seemed so much like a deliberate attempt to deceive the Court, that he granted the injunction as prayed, giving leave to defendant to move to dissolve it if he satisfied the Court that the silence of the affidavit as to the whalebone was not fraudulent or material.

On the part of the defendant, any fraudulent intent was disclaimed, and the form of the affidavit was explained as arising from the fact that the whalebone did not act as a spring, and was, therefore, considered a matter of no importance.

## REVIEWS OF NEW BOOKS.

*Engineering Facts and Figures for* 1868. 8vo. Fullarton, London and Edinburgh, 1869.

WE have already so fully noticed the preceding volumes of this annual, that we need say no more of this, the volume for the year just past, than that it well sustains the character of its forerunners.

We would counsel the omission of all discussion, and confining this work to a compilation of excerpts of whatever may be worthy of more permanent record and reference in applied mechanics during the year, while the range of subjects might probably with advantage be extended.

*Transactions of the Institution of Naval Architects.* Vol. ix. 1868, 4to., plates. Published at the Institution Rooms, 9 Adelphi Terrace, London.

This last volume is as good as its predecessors; perhaps, in one or two papers, better than some of the eight volumes before it.

There is one rather formidable evil that besets the character of a large proportion of the papers brought to the annual meeting of this Institution. It is that they are too much hobbies, trotted out by their authors for very practical purposes no doubt, but these having very often a basis in gold only, the papers are apt to be exaggerative or one-sided; and the politeness of discussions, in which probably friends manage to take a prominent part, do not always counteract too favourable statements, much less expose quackery.

There are some papers to which this applies in this present volume—we shall not risk the odium of specifying them; but, except in the case of two, we really do not see that any very decisive corrective was even attempted to be applied to statements which, left unchallenged, must lead people astray. There are nineteen papers altogether in the volume; the most ponderous—and, shall we say, puffy?—being that upon the well-worn "turret and tripod systems," and that scientifically the most able and important, being the last in the volume, by Professor Rankine, "On the waves which travel along with ships." The doubts thrown upon Mr. Saxby's magnetic methods of detecting internal defects in iron, seem to be strengthened by the fact that, after more than a year has since elapsed, we hear no more about it. M. Rochussen's Paper on the Treatment of Steel Plates is valuable and worthy of reference, notwithstanding that it contains (p. 8) one astonishing statement, viz. "as the mere cost of *melting* crucible steel, both in England and Prussia, is 9*l.* per ton," &c. We had supposed that M. Siemens undertakes to melt cast-steel in crucibles at a total cost of under 1*l.* per ton.

Were more and abler men of applied science to preside as chairmen at these meetings in place of ancient admirals and lords, the character of the papers would prove higher, and doubtful statements would be more effectually exposed.

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*Modern Screw Propulsion.* By N. P. Burgh, Engineer. Parts xv., xvi. and xvii. 4to. Spon, London, 1869.

This work, of which we have already noticed fully, as they deserved, the preceding parts, is now concluded.

These last three parts more than fully bear out the character of those that appeared before them, which is more than can be said generally for works that appear in parts. In these, but too commonly, one or two good parts are issued at first, to act like ground-bait thrown in to attract the fishes, and when these have assured their own capture, the quality of the *pabulum* becomes much deteriorated.

Here, however, the last part is not only double the size of the others (and double the price, we should add), but is certainly one of the most valuable of the entire series. The account given of the various methods practically adopted to resist the end-on thrust of screw-propeller shafts, is the best that has been anywhere given, and the plates that illustrate this are admirable. A very modest preface is given with this concluding part, and upon having reached his goal so well, we congratulate the author.

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*Practical Mining, fully and familiarly described.* By George Rickard. Small 8vo. E. Wilson, Royal Exchange, London, 1869.

This little closely-printed volume, which is pregnantly full of matter, does not belie its title; it is mining, limiting that to British metal-mining, fully and familiarly described, and by a man who obviously has had large experience.

It is, no doubt, impossible to condense into a thin volume of this size, by any process of close type and narrow margins, the whole that can or ought to be said upon so large and so varied a subject, on which much more might be written in the same homely and sensible view as this is characterised by.

But the information given is clear, good, and practical, and we do not know a better elementary work to put into the hands of a lad who has already mastered his schooling and is intended to become a miner; it will at least give him a good panoramic view of what he will be engaged in, and what sort of knowledge he must acquire to succeed as one of that specialised class of engineers called in Cornwall "mine captains."

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*The History and Progress of the Electric Telegraph; with Description of some of the Apparatus.* By Robert Sabine, C.E. 2nd edition, with additions. Virtue & Co., London, 1869.

In 1867, we reviewed Mr. Sabine's large work upon the Electric Telegraph, published by the above-named firm.

That valuable work has here been condensed and recast, so as to form one of the volumes of Weale's Series. All that we need say of it is, that it is put into its present form with its author's accustomed ability and perfect knowledge of his speciality, and with every merit of the greater work, except its fulness, untouched.

We learn from the preface that Galileo, in 1632, anticipated the results that might be obtained by an electric telegraph, though he did not suggest any means to produce one.

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*Inventors and Inventions &c.* In Three Parts: the Philosophy of Invention; the Rights and Wrongs of Inventors; and Early Inventors' Inventories of Secret Inventions. By H. Dircks, C.E. 8vo. Spon, London, 1867.

*Scientific Studies, or Practical in contrast with Chimerical Pursuits.* Two popular Lectures, by H. Dircks, C.E. Reprinted. Small 8vo. Spon, London, 1869.

In the first of the two of these popular Lectures, Mr. Dircks returns to his first biographical love, and the subject of his previous larger and faithfully written biographies, viz. the "Life of the Marquis of Worcester," of 1865, and "Worcesteriana," of 1866. These Lectures, slight as they are, form very pleasant reading, and contain some of the biographical and historical cream of the larger Life of the celebrated and wonderful marquis.

It is peculiarly fitting at this time, when another ignorant and self-sufficient parliamentary onslaught has been just made again upon the patent laws, that we should draw attention to Mr. Dircks's work first above given in title. Without venturing to affirm that we can agree in all the author's views as to the rights and wrongs of inventors, we may say that his views are generally full of good sense and clear thought, and that he individually and practically comprehends what he is writing about, when treating of discovery, invention, and the proper and improper bearings of the existing patent law upon these. Nothing can better show the real incapacity of such legislators, as the openers of the late Debate on the abolition of the patent laws, to deal with the subject, than their confusion of thought as to any distinction between discovery and invention; a confusion, however, from which many inventors' and patentees' minds are not exempt, but which Mr. Dircks labours to clear away. We commend this volume to all interested in patent-law reform, which is urgently needed, and which should be initiated by an effective Royal Commission of enquiry commanded to *hear all* pertinent evidence brought before it, and not contrive merely to hear such as shall suit the foregone views of the Commissioners, as before now has happened.

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## FOREIGN LITERATURE.

*Traité d'Hydraulique et de Géologie agricoles.* Par A. Duponchel, Ing. des Ponts et Chaussées. 1 vol. large 8vo. Lacroix, Paris. Illustrated. 1868.

This work, of which little has been heard in this country, is yet one of a highly noteworthy character. It is, in fact, no less than an attempt, and a very able one, to found a rational agriculture, viewed as an applied physico-chemical and physiological science, upon the basis of those cosmical laws which we see operative around us, and which are unceasingly engaged in new-moulding, and yet preserving the natural fertility of the earth, which tends as unceasingly to "wax old as doth a garment."

These forces of the cosmical machine, which operate upon the surface chiefly of our planet—resoluble ultimately into attraction, heat, and light—work mainly through the aid of water in motion, whether it be that of tides or of rivers, fed by rains and dews.

The first part of the work, then, consists in an orderly exposition of how these work; that is to say, of the physical geology, of the immediate and generally loose actual surface of our globe, the nature of the agencies which *journalièrement*, as the French word well expresses it, from day to day have formed it, and continue to mould it into the forms, the innumerable variety and beauty which constitute the landscape.

In this, as confluent agencies, we have the parts played by rains, torrents, springs, alluvions, sea-coast formations, advancing degradations, deltas, and natural irrigations by inundations, &c., brought into a systematic and clearly explained whole.

In the second part, these principles with the aid of engineering knowledge proper, chiefly hydrological, are applied to the actual work of the higher and greater agriculture, namely, the direction of those natural forces so as to aid man's labour, in replenishing the earth and subduing it, for the purposes and profit of the husbandman.

Our readers must not conclude that, because we have said this work is able and in some respects original in its scientific treatment and theoretic aspect, it is, therefore, not practical; on the contrary, we deem it eminently so, and commend it to the attention of all our great practical agriculturists and steam ploughmen in Great Britain, the country where, beyond doubt, the practice of agriculture is carried to the highest point yet attained in the modern world.

Thus the author concludes his volume with a short account of the project for the fertilisation of the sandy "landes" of Bordeaux, which he has proposed to effect by a vast and comprehensive system of warping out over them coats of fine muddy alluvium; a work which he presents the figures to show would pay 40 per cent. upon the capital to be invested. This work of M. Duponchel is, no doubt, more generally applicable to great continental surfaces, than to the bit of almost garden ground which our England has become; but yet there are vast wastes even on some of our English coasts, and ample scope for the use of knowledge such as the author systematises, in the North of Scotland, throughout much of Ireland, and, need we say? ample scope and verge enough for it in Australia, New Zealand, Canada, and British North America.

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*Ueber Schlammanalyse und einen neuen Schlammapparat.* Von Dr. Em. Schöne. Berlin. 8vo. pamphlet.

This curious, though not unimportant, work upon the theory and practice of analysis or separation, by washing in relation to the specific gravity of the divided materials, the volume of the water, and so forth, the author dates from Moscow; in fact, it is extracted from the Bulletin of the Imperial Society of Naturalists of that city for 1867. The reader will easily guess the class of bodies which in practice the author has in view.

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*Die Industrie der Mineralöle, des Petroleums, Paraffins und der Harze etc.* Von H. Perutz, technischer Chemiker und Fabriksdirector. Vienna, 1868. With Illustrations.

Everyone technically interested in the coal oils, petroleum or paraffine industries, ought to possess this work, which certainly is the most encyclopædic and complete account of all that relates, geologically, geographically, chemically and industrially, to the past, present, and future of this great and fortune-making modern trade, that has yet appeared in any language.

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*Annales et Archives de l'Industrie au XIX^e^ Siècle etc.* É. Lacroix, directeur. Part 39 &c.

Although M. Lacroix, encouraged no doubt by the good public reception of the earlier parts of this account, produced under his direction by very many authors, of the great subjects and objects of interest technically, in the Great Exhibition of 1867, has largely exceeded his original limits, the work has not lost in value or interest as it has proceeded—a fault but too common in works which appear after subscription in successive parts. The last part published, which has reached us, contains stearine manufacture, according to the French method of saponification of the crude oils, which are in many respects essentially different from our British ones; this as one branch of the chemical arts.

A good article on the mineralogical and geological objects of the Exhibition; one on the many excellent, and some very singular, windmills which occupied the Parc; and a very valuable one, with excellent illustrations, on the construction of French omnibuses, from which we in London especially might take lessons with advantage and increased comfort to all.

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*Ueber die Constitution des Roheisens etc., zur Begründung eines allgemeinen Constitutionsgesetzes für dasselbe etc. etc.* Von Ernst F. Durre. Leipzig: Felix, 1868. Small 8vo.

This is a very learned, very minute, painstaking, and thoroughly German production, and of no small service, from the careful quoting of authorities, to those who shall hereafter go again into the great, and as yet most imperfectly understood, subject of the molecular constitution of pig-iron, or of iron in other conditions. The views, as to this, adopted by the author are to a large extent those of Rammelsberg. We cannot say, however, that after turning the 187 pages of the work, which was originally an inaugural dissertation for the Doctorgrad at Göttingen, we have felt that we knew much more than we did previously on the complex subject treated of; while one or two positive advances which have been made in Great Britain within the last ten years or so, as to the laws of arrangement of crystallising metals, appear unrecognised by the author.

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*Balistique des bouches à feu rayées.* Par Martin Prehn. Traduit en Français par Rieffel etc. 8vo. Gauthier Villas, Paris, 1867.

This is a brief but very able work. Its twenty-three lucid chapters exhaust all that is most practically important on the subject of the flight of rifled projectiles.

Colonel Neumann, of the Prussian service, supplies a preface, in which he testifies to the good accord of the formulæ given, and the actual results of experiment.

Those who, in civil occupation, yet aspire to be officers of our Volunteer Artillery Corps, may (if possessed of sufficient preliminary mathematical knowledge) study this work without much weariness and with great advantage.

An artillery officer, without any clear notions on the subject of ballistics, is almost as great a solecism as a naval lieutenant without any knowledge of navigation or the nature of a Mercator's chart.

Yet we fear but few of our Volunteer Artillery could pass muster in even a very elementary examination upon the powers and properties of the instruments of death they are entrusted with.

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*L'Origine des Étoiles filantes.* Par R. Brück, Major du Génie, etc. 1 vol. 8vo. Muquardt, Bruxelles, 1869.

This is an elaborate but somewhat wild attempt to establish a theory of falling stars, or shooting stars, as the author would insist on calling them (as a good deal of his argument rests on the fact that these lights are observed to go in paths *from* the earth—not falling towards it), based upon his already published notions as to the magnetism of the globe. For such of our readers as take an interest in the rapidly expanding knowledge now being attained as to these still mysterious bodies, we notice this work chiefly.

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*Ueber die Elasticität der festen Körper und die optischen Erscheinungen.* By T. Wand, &c. 1 vol. 8vo. Munich, 1868.

This work of Theodor Wand, Consistorial Assessor at Speyer, is purely analytical, and deals with the connection between the elasticity of solids and their physico-optical properties; in fact, generally, the relations of mechanical elastic resistance to molecular elasticity, as called forth through what used to be known as the imponderable agents. The work itself treads in a track that must ere long become rich in results, and one which, in its experimental aspects, has been already pursued by Savart, Senarmont, and others; it is of too ponderous metal for the generality of the readers of this journal, however.

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*Mineralogische Nachrichten.* Von Dr. Carl Zerrenner. Erste Reihe. Felix, Leipzig, 1869. January Part.

This is a new periodical to be conducted by Dr. Zerrenner, who is Mining Director &c. to the Grand Duke of Saxe-Coburg-Gotha,

and is intended to be devoted to what is new, and perhaps we might say transcendental, in mineralogy.

We fear there are too few really scientific mineralogists in these countries of ours to cause for him a very hopeful demand for the work.

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*Die Hochwasser im Sep. u. Oct. im bündnerischen Rhcingebict etc.* Von J. W. Goaz, Cantonsforstinspector. Small 8vo. illustrated. Leipzig, 1869.

This, which is but a large pamphlet, is a very able, interesting, and scientific account by a competent man, one able to take as his standpoint "the natural philosophy and hydrotechnic and foresters' view," as he himself says, of the tremendous inundations produced by the Upper Rhine in the Swiss valleys in the autumn of last year. This little work is worthy the perusal of our water engineers: though no such floods as those here treated of occur in our little islands, yet Australia and India present abundant occasions for having to deal with such phænomena. There are important numerical and meteorological details given, and numerous sections of bridges, gorges, and special points, by which the floods were arrested, and at which the discharges were measured or calculated.

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*Zeitschrift für analytische Chemie etc.* Achter Jahrgang, erstes Heft. 1869.

The first part for this year of this valuable year-book of improvements has appeared. It is needless to say anything in further commendation of this so well-known and highly appreciated work by Dr. C. R. Fresenius of Wiesbaden.

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*Die geometrischen Grundprincipien der Perspective.* Von Dr. H. Hertzer, Berlin, 1868. Pamphlet, illustrated.

This is a terse and clear attempt to educe a sufficient system of practical perspective from purely geometrical considerations and constructions, illustrated by many and very clear diagrams. It is only about 60 small 8vo. pages in all, and would probably be quite worth a translation into English, as being greatly superior to several at least of our elementary treatises on perspective, which abound in obscurities, and sometimes are not even free from mistakes.

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*Dictionnaire de Chimie, pure et appliquée.* Par A. Wurtz et ses collaborateurs. Vol. 1, A—B. Grand 8vo. Hachette, Paris, 1869.

The first volume of this tells well for its future, and if all are conducted with as much ability as this latest Dictionary of Chemistry has been so far, it may prove the most valuable alphabetical arrangement of monographs, embracing the entire range of chemistry pure and applied, as yet extant.

It is in very large 8vo., well printed and illustrated, and with coloured illustrations, where necessary; as, for example, in the *spectra* of elementary bodies given in the volume. The work will be a ponderous one when complete; no intimation of its size is given, but it can scarcely be completed in less than eight or ten volumes of nearly 700 pages each.

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*L'Unité des Forces physiques; Essai de Philosophie naturelle.* Par le Rév. Padre Secchi. Trad. par Deleschamps. Paris, Savi. 8vo. 1869.

This volume, by the well-known Father Secchi, Astronomer of the *Collegio Romano* at Rome, is an attempt to survey the whole field of molecular physics, and to connect, under a single force—that of gravitation—all those classes of actions which belong to heat, light, and electricity &c.

It is no new attempt, nor does it appear to us more fortunate than its predecessors: stripped of the very excellent and able *coups d'œil* given of each of the above classes of knowledge, the rest resolves itself into little more than hypothesis.

At any rate it is not the class of work for us here to enlarge upon, even if we did not greatly prefer the safe though lowly road of experimental investigation, to mere theorising based on hypotheses, however brilliant.

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*Einleitung in die mathematische Theorie der Elasticität und Cappillarität.* Von A. Beer. Herausg. von A. Giesen. 1 vol. 8vo. Leipzig, 1869.

All we need say here of this work is, that it is well deserving the attention of our physico-mathematicians, our Thompsons, Maxwells, and Rankines. It is quite out of the range of our readers generally.

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## CORRESPONDENCE.

☞ We do not hold ourselves responsible for the views or statements of Correspondents.

### THE EJECTOR CONDENSER.

TO THE EDITOR OF "THE PRACTICAL MECHANIC'S JOURNAL."

Sir,—I beg to call your attention to that portion of your description of my Ejector Condenser, at page 85, where it states—"It appears to us that the only difference between the instrument illustrated at plate V. and that now shown by woodcut, fig. 13, is that whilst, in the former case, the nozzles, *a* and *b*, are adjustable in position, so that the areas of their orifices can be regulated according to the quantity of steam requiring to be condensed, in the latter case the nozzles, *a* and *b*, are fixed, so that the instrument is capable of working efficiently with an uniform quantity of steam only. Now, it has, we believe, been ascertained, although sometimes contrarily stated, that intermittent blasts of a gaseous fluid, such as the exhaust steam escaping from a steam-engine cylinder, are not capable of maintaining a continuous flow of liquid in an apparatus wherein the attractive action of the former impels the latter, and that, unless the succession of impulses of the blasts is so rapid as to produce, practically, an unbroken flow of the fluid, the flow of liquid is 'lost.' We presume, therefore, that this circumstance led Mr. Morton to make the central spindle of the ejector *hollow*, as shown at M, figs. 14 and 15."

In the former portion of the preceding paragraph, you state that the only difference which you see between plate V., fig. 1 of my condenser, and woodcut 13 of Morton's is, that my nozzles, *a* and *b*, are adjustable, while those of Morton's are fixed; further on you state that unless the succession of impulses of the blasts is so rapid as to produce practically an unbroken flow of the fluid, the flow of liquid is "lost," and that you presume this circumstance led Mr. Morton to make the central spindle *hollow*, as shown at figs. 14 and 15; these two statements are in my opinion contradictory: in the first place, I may explain that my extension of the central spindle of Giffard's instrument into the water nozzles, was for the purpose of making it take the water when the depth is beyond 5 or 6 feet, or at a high temperature; and this may be used to advantage in both the single and double instruments, when the water is hot, or below that depth; but the central spindle does not form an essential part of the instrument, if the water is within the limits from which it can be drawn by the single steam-jet; its purpose being only to assist the instrument in taking the water at the start, when the water is at too great a depth or too hot; and as the extension of the spindle is a distinct and separate claim in my patent, it may be dispensed with altogether when circumstances will admit; and if you will again compare my instrument, at plate V. fig 1, with Morton's, at woodcut 14, page 86, you will see that it is exactly my instrument, with the central spindle kept out, and which, as I stated above, is not an essential part, when the water is within the limits of the steam-jet to take it. The only slight alteration he has been able to effect is in making the protecting jacket on the centre jet a fixture to the outer casing, instead of to the barrel or steam-tube itself. This appears to be the only alteration for alteration's sake. From this you will see that he has not made the central spindle *hollow*, but has kept it out altogether, leaving my instrument, indeed, without alteration.

Since you have referred to the quantity of steam taken off by the starting jet, I beg to enclose you drawings of a steam-meter which I have designed and constructed for the purpose of ascertaining how much steam is taken off straight from the boiler to propel the water, in place of that power formerly employed for driving the air-pump, and this I intend to apply to the Ejector-Condenser as at present in operation.

Yours truly,
Andrew Barclay.

Caledonia Foundry, Kilmarnock:
*July 12th*, 1869.

Note.—With reference to our Correspondent's remarks, we may observe, that we quite coincide in the view that his own and what is alleged to be Morton's condenser are one and the same thing; and we also admit a slight inaccuracy in the passage quoted by our Correspondent, for clearly the central steam passage M, shown at woodcut fig. 14, page 86, without a central spindle, corresponds to the central steam passage L, at fig. 1, plate V., and having the spindle down its centre, which, as Mr. Barclay explains, may be dispensed with when the lift of water is under five or six feet, and the temperature of the water when the instrument is used as a hot liquid feeder, is not too high. In place of the passage referred to reading as printed at page 85, it should read thus: "We presume, therefore, that this circumstance led Mr. Morton to apply to the instrument a *self-acting* valve situate between the central steam-passage and the boiler, in order that any deficiency in the quantity of steam," etc., as on page 85.

Regarding the apparatus for measuring the flow of steam, we have received the drawings, and shall illustrate them on an early occasion.

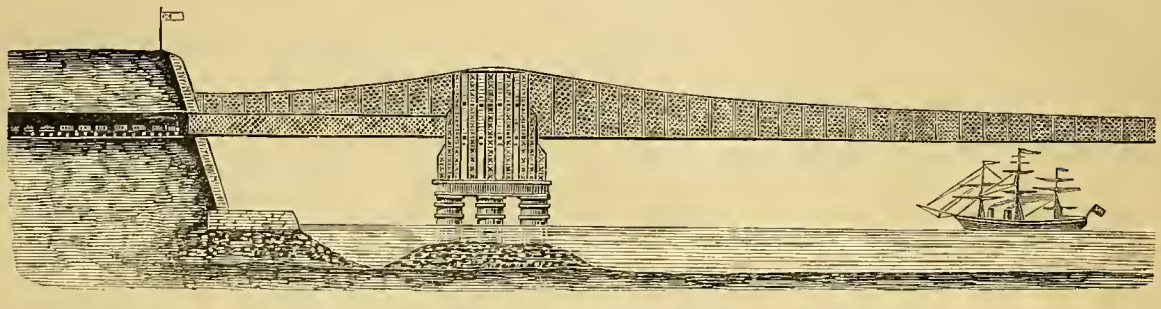
V. D.

## DEEP-SEA RAILWAY BRIDGES.

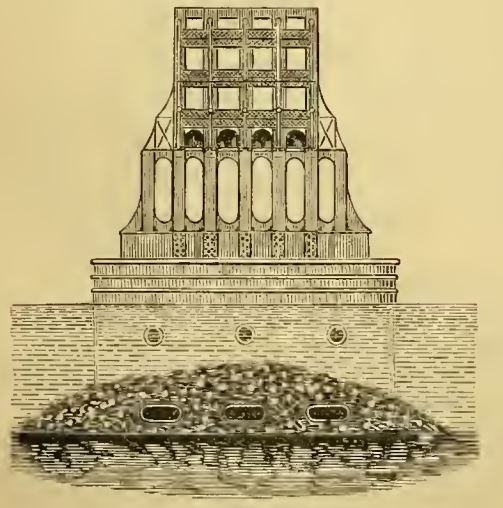
TO THE EDITOR OF "THE PRACTICAL MECHANIC'S JOURNAL."

SIR,—Whatever may be said about the various proposals that have been mooted from time to time for crossing the English Channel, there is no disputing that we should prefer railway communication per bridge, over those schemes underneath the Channel waters, by a submarine work, or at the bottom of the sea through a submerged tunnel—the latter being, in my opinion, the most feasible of them.

The great objection to overhead viaducts is, that the piers would obstruct the navigation; this difficulty we cannot get over, unless we stretch across in spans of such magnitude that ample provision is left for the numerous fleets that at times run up Channel. With spans 1,000 metres, or, say, three-quarters of a mile, between the centres of the piers, there would require twenty-six piers to be laid down, in a depth of water from 75 ft. to 175 ft. M. Boutet's horizontal wire-rope bridges point out a way for constructing such long spans; but I am of opinion that a modification of his system, combining the suspension principle, would be much better. To stretch wire-ropes horizontally the tension would be enormous, and the material would be so much strained that but little stored-up strength would be left for carrying the platform and the usual load allowed for in such structures. Some may say, bridges of this description could not be made rigid and of sufficient strength. I think that is but a one-sided view, as it is the colossal proportion of such a viaduct, in comparison to the locomotive, that renders the structure not only safe but practical. With the track towering 200 ft. above the level of the Straits, the locomotive becomes a mere 'pigmy'—the ball at the top of St. Paul's in comparison to the cathedral. The chief difficulty appears to be the piers; and in laying my ideas before you, I give a design calculated for all bridges that may be required to span rivers and arms of the sea. For a Channel viaduct, the piers would be 390 ft. by 260 ft.; this I consider ample area, and, no doubt, it is colossal, but we must remember that from the bottom of the deep-sea piers at mid-channel to the top of the suspension chain would be little less than 550 ft.



The annexed engravings show the method I would adopt: three hollow piers are constructed of metal, securely joined together, and filled in with concrete; each pier is to have an outer and inner skin, firmly trussed, having a double metallic bottom, likewise filled in with concrete. They could be erected in shoal water, and, as the structure progressed, moved into deeper water with suitable pontoons, and so on, until the whole depth had been laid on; then the pontoons would be sunk deeper by allowing water to enter them, and when sufficient depth had been attained, they would be securely attached to the mass, and the water pumped out. Thus the whole fabric would be buoyed up; then the "Great Eastern," we will



say, would tow the huge structure to its destination. It will be seen that there is a sluice fitted inside of each pier; this is required to allow a little water inside to resist the head of water. On arriving at its destination the sluice would be opened, as likewise those in the pontoons, and the mass would sink until finally resting on a level bed. Hydraulic or screw piles may be fitted inside each pier, so as to adjust the level, but probably this would not be required; after they had become settled down, the inside of the piers would be filled in with a stiff clay, small stone &c.; thus we would have an almost solid pier, of great stability and weight, to rear the structure upon, and resist the troubled waters of the Channel. The main difficulty, we may say, has been accomplished, and it remains for us to place on the top, girders, binding the three piers at the top, and then erect the light wrought-iron pedestals thereon, for carrying the network of suspension ropes &c. I consider it would be advisable to fill in these girders with concrete, so as to render them better able to resist the crushing stress. As regards the wire-ropes, they would be stretched across in the usual manner; a number of, say, 2-inch ropes forming the main suspension chain, while the others would be arranged underneath, similar to M. Boutet's plan, stretching from pier to pier, the depth at the centre, and all the other ropes at intermediate distances, each rope having a means of tightening-up with right and left screwed coupling-links. Prior to that, the vertical suspending-bars should be laid on for carrying the bottom beams or longitudinal webs, for the cross girders to rest on; the whole of the tension ropes would be laced in the length of the bridge, forming the meshes of the great suspension chains; they would, likewise, be united with distance pieces and cross wirework transversely. Thus, I consider, a strong bridge for great spans could be constructed.

As regards the site for, say, the Channel, that fixed by the French engineer seems as good as any, and whether the mode I have shown of securing the chains to the cliffs, with a lattice girder, as the first span, and tunnelling through the cliffs, may or may not be the best, does not alter the object I have mainly in view, namely, pointing out a very different mode of constructing deep-sea bridges than what has been formerly advocated, and merely give it as an improvement, and in nowise antagonistic to the great horizontal wire-rope bridge of our Continental friends.

I am, yours truly,

13 Gladstone Street, St. George's Road: JOHN G. WINTON.
9th July 1869.

## PROCEEDINGS OF SCIENTIFIC SOCIETIES.

### ROYAL INSTITUTION.

MAY 13th, 1869.—Professor Tyndall began his sixth lecture on "Light" with an experiment illustrating the cause of Fraunhofer's lines in the solar spectrum. He placed a small piece of charcoal on the lower carbon of the electric lamp, and surrounded the piece of charcoal with pieces of sodium, chloride of lithium, and other salts. When the piece of charcoal was ignited to intense whiteness in the electrical current, it represented a miniature sun; the heat also raised the sodium and other substances to the state of luminous vapours, thereby representing the atmosphere of the sun. The spectrum of the whole was thrown upon the screen, and was seen to be cut by many lines, all representing the substances in the vapours surrounding the piece of charcoal. Now and then the sodium line became quite dark from absorption by the metallic vapour. When carbon is used alone, without other chemicals to produce a vaporous atmosphere, there are no lines in the spectrum. On this principle, by examining and mapping the lines given by the spectrum of the light of the sun, it is known what substances are present in a state of intense ignition in the solar atmosphere.

In another absorption experiment, wherein a solution of permanganate of potash was made to act upon the spectrum, it was shown that this beautifully-coloured liquid lets the red and violet rays of the spectrum pass freely, but absorbs the green, yellow, and many of the blue rays.

He then passed to the subject of the interference of light, and said that in wave motion we must clearly distinguish the motion of the wave from the motion of the individual particles which at any moment constitute the wave. For while the wave moves forward through great distances, the individual particles of water concerned in its propagation perform a comparatively short excursion to and fro.

In speaking of diffraction, or the inflexion of light, Professor Tyndall said that Newton, who was familiar with the idea of an ether, and, indeed, introduced it in some of his speculations, objected that if light were propagated by waves, shadows could not exist; for that the waves would bend round opaque bodies, and abolish the shadows behind them. According to the wave theory, this bending round of the waves actually occurs, but the different portions of the inflected waves destroy each other by their interference. This bending of the waves of light round the edges of opaque bodies receives the name of *diffraction* or *infraction* (German, *Beugung*).

MAY 14th.—Mr. W. H. Perkin gave a lecture on the "Newest Artificial Colouring Matters."

MAY 15th.—Professor Seeley (the reputed author of "Ecce Homo") gave his second lecture on "Roman History."

MAY 18th.—Professor Grant, F.R.S., in this lecture on "Stella Astronymy," spoke principally of the method of measuring the velocity of light by obser-

vations of the eclipses of Jupiter's moons; and he then entered into details respecting the phenomena of the aberration of light, and the effect of such aberration upon the apparent motions of the stars.

May 20th.—Professor Tyndall, in this lecture upon "Light," explained the philosophy of the experiment shown at the close of his last one.

May 21st.—Mr. H. C. Fleeming Jenkin, F.R.S., in the course of a lecture upon "The Submersion and Recovery of Submarine Cables," said that his object was to explain the principles on which engineers had acted in laying and recovering submarine cables rather than to exhibit the details of the machinery employed.

The general construction of electrical cables was first described, and specimens were shown, especial attention being drawn to the deep-sea French Atlantic cable, consisting of the following parts:—A copper conductor, gutta-percha insulator, and, jute serving, surrounded by ten wires of homogeneous iron, each served with five Manilla yarns saturated with tar. The wire served with hemp will bear a greater weight than the sum of the weights borne separately by the wire and the strands; and, again, the ten served wires, when formed into a rope, bear a greater weight than the sum of the weights which each will bear.

Moreover, while the homogeneous iron elongates less than 1 per cent. before breaking, and the hemp elongates only 0·75 per cent., the two combined stretch 3 per cent. This paradoxical result is due to want of absolute uniformity in the strength of each part. When separate, each cracks at the weakest point; when combined, the weakest points seldom coincide. Hence the strength of the combination is the sum of the mean strengths of the parts, necessarily greater than the sum of the minimum strengths.

The manner of coiling the cable on board ship was explained by diagrams and models, it being shown that, in order to avoid putting a twist into the rope when taking it out of the hold, it was necessary to put a twist in when coiling it away.

May 22nd.—Professor Seeley, on this date, delivered the last of his three lectures on "Roman History."

May 25th.—Professor Grant, F.R.S., in this lecture on "Stellar Astronomy,' called attention to star-clusters and nebulæ. He said that as yet astronomers know next to nothing about the physics of the nebulæ. Mr. Huggins' researches give some information about the nature of the light emitted by these vast bodies; but beyond that little is known.

May 27th.—Dr. John Tyndall, F.R.S., in his eighth lecture on "Light," began with the subject of double refraction. He said that in air, water, and well-annealed glass, the luminiferous ether has the same elasticity in all directions. There is nothing in the molecular grouping of these substances to interfere with the perfect homogeneity of the ether. But when water crystallises to ice, the case is different; here the molecules are constrained by their proper forces to arrange themselves in a certain determinate manner.

May 28th.—Mr. J. Norman Lockyer, F.R.S., gave a lecture on "Recent Discoveries in Solar Physics made by means of the Spectroscope." He said that in the year 1865 two very important memoirs dealing with all the telescopic and photographic observations accumulated up to that time on the subject of solar physics were given to the world. One of them was privately printed in this country, the other appeared in the *Compte Rendu* of the Paris Academy of Sciences.

He did not give a lengthened notice of these remarkable papers. He merely referred to the explanation given in both of them of the reason that a sun-spot appears dark—the very keystone of any hypothesis dealing with the physical constitution of the sun.

English Science, represented by Messrs. De la Rue, Stewart, and Loewy, said that a spot is dark because the solar light is absorbed by a cool, non-luminous, absorbing atmosphere, pouring down there on to the visible surface of the sun, in other words, on to the photosphere. French science, represented by M. Faye, said that a spot is dark because it is a hole in the photosphere, and the feebly luminous and therefore radiating interior gases of the sun are there alone visible. Now here was a clear issue, which probably the spectroscope, and possibly nothing else, could solve; for the spectroscope, said the lecturer, is an instrument whose special *métier* it is to deal with radiation and absorption. It tells us that the light radiated from different bodies gives us spectra of different kinds, according to the nature of the radiating body,—continuous spectra without bright lines in the case of solids and liquids, and bright lines, with or without continuous spectra, in the case of gases and vapours. It tells us also that the absorption dims the spectrum throughout its entire length when the absorption is *general*, and dims it here and there only when the absorption is *selective*, the well-known Fraunhofer lines being an instance of the latter kind; so that we have general and selective radiation, and general and selective absorption. With regard to the English theory, if there were more absorption in a spot than elsewhere, we might expect evidences of absorption; that is, the whole solar spectrum would be visible in the spectrum of a spot, but it would be dimmed, either throughout the length of the spectrum or in places only. With regard to the French theory, radiating only gaseous matter to deal with, we should, according to the then generally received idea, get bright lines only in the spot spectrum. Here then was a tempting opportunity, and one which he considered himself free to use; for although the spectroscope had then been employed for four years in culling secrets from stars and nebulæ, there was not, so far as he knew, either published or unpublished observation on the sun, the nearest star to us. The field was therefore open for him, and he was not entering into another man's labour, when, on the 4th of March 1866, he attached a small spectroscope to his telescope, in order to put the rival theories to a test, and thus bring another power to bear on a question which had remained a puzzle since it was first started by Galileo some two-and-half centuries ago. It is sufficient here to mention that what Mr. Lockyer observed was in favour of the English theory. There *was* abundant evidence of absorption in the spots, and there *was not* any indication of gaseous radiation. We regret that we cannot devote more space to the details of this important lecture.

## CIVIL AND MECHANICAL ENGINEERS' SOCIETY.

At an ordinary meeting of the above Society, held on the 9th ult., Mr. W. Forsyth Black, C.E., in the chair, an interesting paper on steam and other power hammers was read by Mr. Frederick H. Roberts, C.E. (member of Council).

The author referred in detail to some of the earlier machines, such as the helve or tilt hammers used for shingling, forging blooms, and shafting, tilting steel, &c.; but, as this class of machine depended, to a great extent, for raising the hammer and its connections either through the direct medium of cams, eccentric or similar arrangements, it followed that the power required to work them was extremely large, and the parts of the machine itself very heavy and cumbersome to withstand the consequent strains. It was also found that the larger the mass of metal to be worked, the lighter the blow given, and, conversely, the smaller the mass, the heavier the blow; it was, therefore, ill adapted for heavy forgings. The invention of the steam hammer solved the difficulty which was found to exist, and to it, to a considerable extent, is due the perfection obtained in all classes of machines where ponderous forgings are found to be absolutely necessary.

The first idea with reference to the steam hammer the author traced as belonging to that great engineer, James Watt, who obtained a patent in 1784 for heavy hammers or stampers for forging iron, copper, or other metals without the intervention of rotative motion, by fixing the hammer head either directly to the piston or piston rod of the engine. Another patent followed this in 1806, by a Mr. Deverell. He proposed to admit steam underneath the piston of an engine by means of a valve, and during its up-stroke the air at the top of the piston was compressed by the pressure of steam beneath, which was released at the proper moment. The compressed air on the top of the piston, in addition to the gravity of the hammer head, was to give the blow. But neither of these ideas were put into practice at that period, and it was not until 1837 that any practical design was put forward for a steam hammer, and then by Mr. Nasmyth, of Patricroft, who urged its superiority for working metal over all other machines, but was unable to procure its adoption until about 1840, when he found that M. Schneider, of Creusot, profiting by his design, had constructed a machine on his plan. In 1842 he obtained a patent for his steam hammer, and from that time it became a recognised power and a necessity in all works of importance. The facility which it afforded for executing all kinds of forging had the effect of greatly increasing the quantity of work to be done, and effecting a material saving both in time and labour.

The steam hammer, as originally constructed, required the valves being worked by hand, which left the machine in the power of the workman to give proper efficiency. The valves were also very difficult to work. This plan answered for the time for small machines, but where rapid motion was necessary, and for larger hammers, it was unsuitable. Several designs for self-acting motion, therefore, followed in quick succession. The author then referred to the different designs that had been introduced for this purpose. In the ordinary self-acting hammer, the man has to watch the metal under operation, and, as its form and position change, he must set his valve gear to suit as near as possible. The author, considered that the motion, to be properly self-acting, should be independent of the workman as regards the adjusting of the gear to suit the varied thicknesses of the metal on the anvil; and, in order to obtain the full force of the blow, it should reverse simultaneously with or immediately after the blow is given, and at whatever point in the stroke the blow takes place. He considered that was accomplished in Sturgeon's double-action hammer, where the blow itself was made use of as the agent to work the valve, and described the mechanism employed; also the various types of double-action steam hammer; likewise the numerous modifications and improvements effected. The author then spoke as to the specialities of the heaviest classes of steam hammers of modern date, including those of Mr. Ramshottom's design; likewise those erected for M. Krupp, at Essen.

With reference to machines of a lighter class, the author described the various designs for power hammers, and referred to the patent pneumatic hammer, several of which he had erected, and which are specially adapted for general smithy work, or light forgings, planishing and heating out metal, &c. It is extremely simple in action, working by means of the alternate exhaustion and compression of air within two cylinders, in one of which is a piston, to which the hammer head is connected by means of the piston rod. By opening a small valve, the vacuum formed within the cylinder is destroyed, and the blow weakened or stopped instantly, according to the amount of the valve opened. These machines are capable of working up to 500 blows per minute when required. At some future opportunity, we purpose to refer further in detail to this machine, and to illustrate the general arrangement, as adopted by several engineers and coppersmiths. The meeting was well attended, and a good discussion ensued.

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Iron and Steel Institute.—Recently, at the rooms of the Society of Arts, the first meeting of the newly-formed Iron and Steel Institute, which was very fully attended by ironmasters from the North, Lancashire, South Staffordshire, South Wales, Middlesborough &c., was held under the presidency of his Grace the Duke of Devonshire, the president, who delivered a lengthy and exhaustive inaugural address. His Grace explained the objects of the Institute, which are to afford a means of communication between members of the iron and steel trades upon matters bearing upon the respective manufactures, excluding all questions connected with wages and trade regulations, and to arrange periodical meetings for the purpose of discussing practical and scientific subjects bearing upon the manufacture and working of iron and steel. He reviewed the success which had attended the formation of scientific and agricultural societies, and saw no reason why equal advantages should not accrue to the iron trade by association. Then his Grace passed on to review the early history of iron, the manufacture of which was mentioned by Homer and Hesiod, and had been asserted by Mr. Layard to have been known in Assyria in 900 B.C. He then noticed the early methods of manufacture down to the period of the use of coal, which gave such a vast impetus to the manufacture of iron in this country, and afterwards referred to the invention

of the "hot blast," the increased supplies of ore, and other causes which had contributed to the present importance of the iron manufacture. The processes by which pig iron, malleable iron, and steel are manufactured having been alluded to, the President referred to the utilisation of the waste of gases from the blast furnaces, and went on then to show how the raw material and manufacture were distributed over the world. The problems now to be solved which were of the most importance were economy in the consumption of fuel and a greater utilisation of the waste gases. Mineral oil had been used in the dockyards in place of coal. It was also highly important to obtain the metal as pure as possible, and though chemistry had been brought to the aid of the manufacture, yet the chemistry of iron and steel was still in many respects obscure and uncertain. His Grace concluded by a brief but eloquent reference to the importance of iron as an essential necessary of civilised life. Mr. Richard Fothergill, M.P., moved a vote of thanks to his Grace for his address, and requesting that it should be printed. Mr. Isaac L. Bell seconded the resolution, which was carried by acclamation.

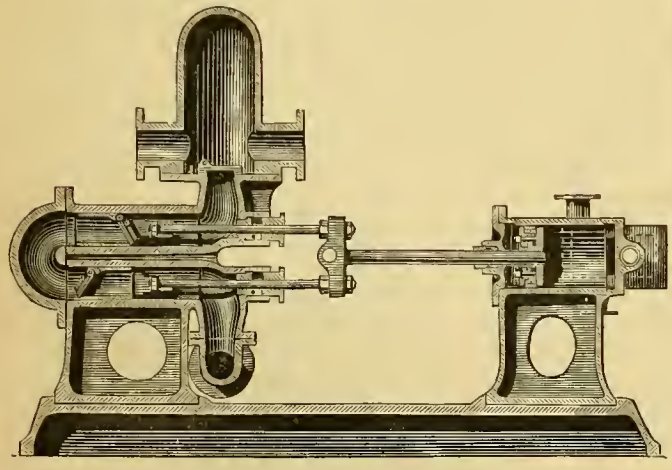
## MONTHLY NOTES.

A new Application of Aluminium.—Amongst the variety of purposes to which this metal has been applied, the latest we hear of is its use in dentistry in substitution of gold and the precious metals for the construction of plates for artificial teeth. Its use in this respect has been introduced and patented by Mr. Wallace, surgeon-dentist at Glasgow. The defect hitherto experienced in using aluminium in cases where the parts required to be united together was the difficulty of soldering it, for we are given to understand that it melts at a lower temperature than any metallic solder we possess. Mr. Wallace sought for a non-metallic solder, and unites the parts together by vulcanite.

Trade-Marks in France.—The *Solicitors' Journal* gives particulars of a recent decision of the Court of Cassation with respect to the rights of the English in France as to trade names and marks. From this it appears that English manufacturers and traders may henceforth confidently sue in France all usurpers of their trade name, provided they prove that they have been the first to make use of that name. "As to the trade-mark," it is added, "there could be no doubt upon the subject since the treaty; but the English commercial public should be made to understand that no action can be brought on such a matter, either by a French subject or an alien, unless the trade-mark has been previously registered and deposited in the proper form. Foreign trade-marks are to be deposited at the Tribunal of the Seine, the seat of which is Paris."

Steam and Force Pumps.—The annexed engravings represent respectively an arrangement of horizontal double-action steam-pump, and vertical double-action force-pump, which have been at work for some considerable time, and found to give results of a highly satisfactory nature. They are the invention of Mr. J. Brown, engineer, now of St. Petersburg, to whom we are indebted for the description and drawings of the same.

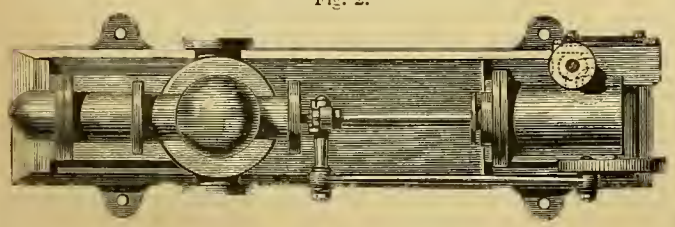
Fig. 1.



In our number for April last we described (and illustrated by plate 15) a multitubular boiler, also the invention of this gentleman.

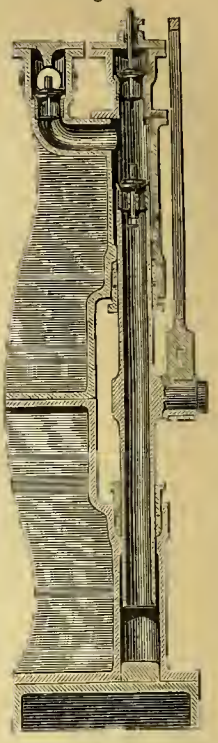
Fig. 1 of the engravings is a longitudinal vertical section of the horizontal double-

Fig. 2.



action steam-pump; and fig. 2 is a plan of the same. This pump is on the principle of the hydropult, and is driven by steam direct from the cylinder of a steam-engine, as shown in the engraving. The valve of the steam-cylinder is worked by a small pin which projects from the head of the crank-shaft. This pin is set excentrically, equal to the throw of the valve, and works in a slot made for it in the face of the valve itself. The shaft is placed at the back end of the steam-cylinder, and works in a hub cast on the cylinder; it is entered from the steam-chest end, and to prevent any steam passing through along the shaft, the slide valve is made long enough to cover the aperture through which the shaft works. In order to take off the pressure from the back of the slide, it is covered by a plate. On the other end of the crank-shaft there is placed a disc with a crank-pin, on which is a connecting-rod, the other end of which rod is fastened to a stud placed in the cross-head of the piston-rod, to which also are fastened the two pump-rods. The two valves in the pump-bucket open in opposite directions, so that in the forward stroke one opens whilst the other closes, and vice versâ in the back stroke; the water flowing always in one direction in a continual stream.

Fig. 3.



The vertical double-action force-pump, illustrated by fig. 3, has three valves, situate at the bottom and top respectively, and in the head of the hollow plunger which works in the two barrels of the pump. The water flows in through this pump, is always in one direction, exhausts in both barrels alternately, and forces at the up stroke. It is worked by an excentric or crank from the engine or other shaft, by two rods which are connected to two necks placed in the middle of the plunger between the two barrels of the pump; or by one rod, the two barrels guiding the plunger in a vertical direction, as shown in fig. 3.

This force-pump is found to work well, without any shock on the valves, as the flow of the water is not checked on the return stroke of the plunger, but continues to flow on through the hollow thereof into the upper barrel of the pump, whence it is forced out on the return stroke of the plunger.

Watering Troughs for Railway Trucks.—Two of the cattle trucks of the North British Railway Company which have been fitted up with Mr. Reid's patent troughs and hay-ricks for watering and feeding cattle while travelling were recently exhibited in the company's new goods shed, Leith Walk. The two trucks are differently fitted up, but in each the construction of the apparatus is exceedingly simple. The trucks are covered, and enclosed as much as possible at the sides, so as to protect the animals from the weather. Mr. Reid's intention is to have three kinds of trucks—first-class, second-class, and third-class—the rates for conveyance in which will be regulated accordingly. Those shown were second and third-class descriptions. The first-class, which is now in course of construction, will be provided with padding within, so as to prevent the cattle from being bruised by the concussions of the train. The difference between the second and third-class trucks consists chiefly in the arrangement of the troughs, and the second-class arrangement is that which will be applied to the first-class waggons. There are to each truck four troughs, two on each side. The space occupied by the doors prevents the troughs being carried the entire length of the truck; but each trough holds something like ten gallons of water, and two applications only of the hose are requisite to supply a truck, as a pipe at each end forms a communication for the water to run from side to side. A swinging door can be bolted to the inner side of the trough, so as to debar the cattle from access to it while the train is in motion; and when the train is standing, and the water is supplied, the bolts are lifted and the door swung out. The bolts resting against the outer side of the trough prevent the door from swinging back to the inner side, and the heads of cattle coming against it may keep it quite beyond the trough. Plugs are provided in the troughs for cleansing purposes, so that the cattle need never have dirty water offered them. In the third-class trucks the troughs have not these swinging doors, but are within the fixed framework, and always open to the cattle, the hose being introduced through a hole at each end of the truck. These troughs are not likely, of course, to remain so long clean as those which are protected from the cattle while the train is in motion. The hay-ricks, formed of slender iron bars, are placed in the upper part of the waggon immediately above the troughs, and are supplied from the outside. The ends of the waggons are entirely closed, the only part of the apparatus which is connected with them being the small pipe forming the communication between the troughs. Mr. Reid's invention is so very simple and serviceable that it cannot too speedily be brought into general application.—*Scotsman.*

Paper Belting.—Messrs. Crane and Co., of Dalton, Massachusetts, have succeeded in making belting from paper, and the article is now used in all their own mills and several other manufacturing establishments. The belting resembles the genuine oak-tanned leather, and serves alike well in a dry or damp atmosphere.

Utilisation of Blast-Furnace Slag.—The following method is now adopted in several ironworks in Belgium:—The slag is allowed to run direct from the furnace into pits about eight or nine feet in diameter at the top, with slides sloping inwards towards the centre, where they are about three feet deep. The mass is left for eight or nine days to cool, when a hard, compact, crystalline stone is obtained, which is quarried and used for building purposes, but chiefly for paving-stones. They appear to wear exceedingly well, being quite equal to the grits and sandstones already so much used.

APPLICATIONS FOR

# PROVISIONAL PROTECTION FOR INVENTIONS

## UNDER THE PATENT LAW AMENDMENT ACT.

☞ When the city or town is not mentioned, London is to be understood.

*1st June* 1869.

1685 F. A. Calvert, Manchester—Motive power
1686 T. R. Clarke, W. Bywater, T. Lawson, and C. L. Lister, Leeds—Manufacture of felted fabrics
1687 A. Rnshworth, Nottingham—Circular knitting machines
1688 C. H. Gardner, West Harding Street, Fetter Lane—Improved lubricator
1689 O. Barrett and G. P. Wheeler, Mitcheldean, Gloucester—Mortar for building purposes
1690 J. Warhurst, Whaley Bridge, Cheshire—Apparatus for closing the aperture or opening at the bottom of hinged doors, shntters, and windows
1691 H. Browning, Limehonse—Compositions suitable for nse as varnish or paint
1692 J. S. Stnhbs, Lincoln—Steam-engines
1693 C. F. Waldo, Bread Street, Cheapside—Sewing machines.—A com.
1694 J. A. Bindley, Burton-on-Trent, Stafford—Attemperator for nnion and tnnning casks

*2nd June* 1869.

1695 M. Wrigley, Oldham, Lancaster—Apparatus for the prevention of accidents npon railways
1696 R. B. Cooley, Nottingham—Manufacture of hats
1697 J. Fletcher, Ashton-under-Lyne, Lancaster—Steam and other cocks applicable to union joints
1698 J. Urbain, Ivry-sur-Seine, France—Wax and other like candles
1699 A. Watt, New Cross, Kent, and T. Knowles, Edgbaston, Birmingham—Manufacture of printing surfaces
1700 G. V. Turnbull, C. Salvesen, and R. Irvine, Leith, N.B.—Preparation of lubricants or softeners
1701 B. J. B. Mills, Southampton Buildings—Low-water indicator or alarm for boilers.—A com.
1702 N., G., and E. Smith, Thrapston, Northampton—Cutting and skiving leather, &c.
1703 J. H. Smith, East Road, City Road—Velocipedes
1704 E. Bemelmans and A. Van Volxem, Brussels—Apparatus for workiug the signals and switches or points of railways
1705 F. R. A. Glover, Brading, Isle of Wight—Anchors
1706 H. Larkin, Leighton Road, and W. White, Thurlow Road, Hampstead—Manufacture of magnesinm
1707 T. B. Worth, Stourport—Mannfacture of carpets, coach lace, &c.
1708 C. Francis, Austin Friars—Railway goods-wagons.—A com.
1709 C. Francis, Austin Friars—Moorings.—A com.
1710 A. L. Simpson, Stowmarket, Suffolk—Compositions snitable for treating sheep attacked by fly

*3rd June* 1869.

1711 Carl Ostlund, Stockholm—Lamps for heating and lighting purposes
1712 B. F. Weatherdon, Chancery Lane—Safety-bag for conveying despatches or other articles of valne by sea.—A com.
1713 J. Hopkinson, Leeds—Artificial fuel
1714 W. R. Lake, Southampton Buildings—Apparatus for generating steam and for heating and cooling fluids.—A com.
1715 J. Lloyd, Shifnal, Salop—Fans for ventilating
1716 J. Stewart, Poplar, and T. Charlton, Ashford, Kent—Multitubnlous and water-sheet steam-boilers and their fire-boxes or furnaces
1717 F. Rave, Manchester—Extracting colour from vegetable matter
1718 J. and R. Tatham, Rochdale—Carding wool
1719 W. V. Morgan, Cannon Street—Crucibles.—A com.
1720 E. Rolfe, Manchester—Utilising for commercial purposes the exterior blank spaces of envelopes, &c.
1721 J. H. Johnson, Lincoln's Inn Fields—Mannfacture of iron.—A com.
1722 J. C. Norman, Camden Town—Agricultural implements
1723 C. W. Petersen, Norton Folgate—Lifeboats

*4th June* 1869.

1724 J. Edge, Bolton-le-Moors—Steam-engines
1725 E. S. Jones, Liverpool—Velocipedes
1726 E. T. Hnghes, Chancery Lane—Wood-boring instruments.—A com.
1727 J. Farmer, Cannock, Stafford—Reaping and mowing machines
1728 T. Best, Fannce Street, Kennington Park—Velocipedes
1729 W. H. Nicholson, Manchester—Travelling portmanteaus
1730 G. W. Ley, Croydon—Manufactnre of ornamental articles in wood in imitation of carving
1731 J. Duke, Mannamead, near Plymouth—Mannfacture of plaster and cement
1732 E. M. Syer, jun., Dalston—Sleepers
1733 R. B. and R. G. Plum, Worcester—Sewing machines
1734 F. Lewis, Dublin—Bottles or vessels for perfumes, medicines, &c.
1735 G. E. King, New York, U.S.—Inted, crimped, and puffed fabrics
1736 J. Blomfield, Colchester, Essex—Sewing machines
1737 T. Wilkins and W. Fisk, Ipswich, Snffolk—Apparatus for slicing cucumbers, &e.

*5th June* 1869.

1738 A. B. Childs, Mark Lane—Machinery for cleaning and decorticating wheat, &c.
1739 H. Downie, Corstorphine, Midlothian, N.B., and I. B. Harris, Edinburgh, N.B.—Shoes for horses
1740 E. G. Brewer, Chancery Lane—Brakes.—A com.
1741 K. Cook, Bishopwearmouth, and G. Hauxwell, Durham—Apparatus for decorticating and cleaning grain and seed
1742 T. W. Arkle, Liverpool—Extracting, recovering, or collecting copper from water containing the same in solution
1743 A. Wiglesworth, Liverpool—Curtain poles
1744 F. H. Holmes, Mortlake—Electro-magnetic machines
1745 R. Law, Burnley, Lancaster—Throstle spinning and doubling frames
1746 A. C. Engert, Tabernacle Row—Plain and ornamental mouldings for picture frames and other uses
1747 H. Kinsey, Nottingham—Steam and other boilers, and surface condensers
1748 A. M. Clark, Chancery Lane—Motive power.—A com.
1749 J. and S. W. Varley, Leeds—Treatment of wool, flax, silk, &c.
1750 W. B. Leachman, Leeds—Improvements in boilers for generating steam, and in apparatus for warming buildings
1751 F. Hohmann, Ipswich, Suffolk—Sewing machines
1752 W. R. Lake, Southampton Buildings—Reins for controlling saddle horses.—A com.

*7th June* 1869.

1753 G. A. Frebault, Paris—Electoral box
1754 C. Gall, Halifax—Steam boiler and other furnaces
1755 B. F. Weatherdon, Chancery Lane—Tension swivel-coupling for nautical and other purposes.—A com.
1756 J. G. McKirdy, Birkwood, Lesmabagow, Lanark, N.B.—Stile or biped pass for parks or other enclosures
1757 H. Smith, Hereford—Reaping and mowing machines
1758 F. Heckner, Brunswick—Endless sawing machinery
1759 W. Sellers, Keighley, York—Sewing machines
1760 G. Fenner, Fletching, near Uckfield, Sussex—Bits for horses
1761 T. G. Greenstreet, New Kent Road—Street-sweeping machine
1762 W. E. Newton, Chancery Lane—Apparatus for folding printed sheets of paper.—A com.
1763 E. Tavernier, Lille, France—Combing wool, cotton, and other fibrous substances
1764 C. E. de Lorière, Great Suffolk Street—Linked buttons and studs for fastening cuffs, &c.

*8th June* 1869.

1765 A. Williams, Bankside—Gas-stoves
1766 B. J. B. Mills, Southampton Buildings—Obtaining lithographic compositions or printing surfaces—A com.
1767 H. Carter and G. H. Edwards, Bow—Breech-loading firearms
1768 D. Cole, Bitterne, Southampton—Anchors
1769 M. Micbel, Edinburgh—Aërial navigation
1770 A. Gardiner, Manchester—Checking the receipts of omnibus guards, &c.
1771 W. Cubley, Newark, Nottingham—Drawing-boards
1772 A. M. Clark, Chancery Lane—Propelling vessels.—A com.

*9th June* 1869.

1773 V. J. Four, Marseilles—Box for containing matches
1774 W. E. Gedge, Wellington Street, Strand—Apparatus for treating leather to render it suitable for making straps, belts, or bands.—A com.
1775 R. Roberts, Little Bolton, Lancaster—Mechanical and artificial dentistry
1776 D. J. Field, Ashton-on-Mersey, Chester, and I. W. Lister, Rochdale—Machines for compressing wool or other substances
1777 J. Mabson, Norwood, Surrey—Sewing-machines
1778 A. J. Billing, Chelsea—Roller-blind furniture
1779 W. Madders and J. Wood, Manchester—Machinery for embroidering
1780 J. T. Twigge, Edinburgh—Velocipedes
1781 H. W. Hammond, Manchester—Hammers for forging metals, &c.—A com.
1782 A. St. Cyr Radisson, Lyons—Treatment of oleine and other fatty matters for the purpose of transforming them into solid materials suitable for the manufacture of candles
1783 E. Bishop, Sheffield—Shears
1784 N. R. Hall, Rosherville, Kent—Apparatus for weighing letters
1785 W. L. Wise, Adelphi—Artificial fuel.—A com.
1786 W. Chambers, United University Club—Refrigerating and ventilating carriages, trucks, &c.
1787 G. Johnson, Coventry—Looms for weaving ribbons, trimmings, &c.
1788 R. Harrison, Port Madoc, Carnarvon—Apparatus for squaring or dressing roofing slates and counting and registering the same, and loading the slates on to waggons or trucks

*10th June* 1869.

1789 C. Denbeigh, Ironmonger Lane—Velocipedes
1790 G. Fry, Bishopsgate Street Within—Treatment of wood for obtaining fibre for the manufacture of paper and cordage, &c.
1791 G. Bedell, St. John, New Brunswick—Apparatus for re-adjusting railway locomotives, carriages, and other rolling stock thrown off the metals of railways and tramways.—A com.
1792 J. Blair, Manchester—Manufacture of wadding
1793 J. Riley, Shoreditch—Roofs and other parts of buildings
1794 T. Hodgson, Manchester—Manufacture of wire-cloth or gauze used in the manufacture of paper
1795 J. Foster and J. Hollinrake, Bury, Lancaster—Apparatus for the prevention of smoke in furnaces
1796 W. Cook, Highbury—Apparatus for taking photographic pictures
1797 W. R. Lake, Southampton Buildings—Covering for floors, &c.—A com.
1798 W. A. Gilbee, South Street, Finsbury—Conveyance and transportation in pneumatic tubes.—A com.
1799 J. G. Marshall, Leeds—Velocipedes
1800 G. W. Oliver, Liverpool—Manufacture of explosive powder.—A com.

*11th June* 1869.

1801 W. A. Lyttle, Hammersmith—Electro-telegraphic apparatus
1802 E. T. Hughes, Chancery Lane—Cutting and dressing stone.—A com.
1803 A. A. Ardisson, Paris—Apparatus for stopping horses
1804 W. E. Newton, Chancery Lane—Submarine drilling apparatus.—A com.
1805 C. Stuart and W. Walker, Manchester—Apparatus for expanding the ends of boiler and other tubes, and also for plugging the same when required

*12th June* 1869.

1806 J. Hill, Wolverhampton—Furnaces for steam boilers
1807 R. Duckworth, W. Greenwood, J. Pearson, and J. Langtree, Blackburn—Apparatus or appliances to be employed for sizing and warping yarns and for weaving
1808 R. Wilson, Blackburn—Fasteners for neckties
1809 A. Lafargue, Newcastle-on-Tyne—Apparatus for weighing and registering
1810 J. H. Riddell, Cheapside—Joints or connections for uniting and securing together the ends of pipes or tubes
1811 G. W. Howe, Regent Street—Steam gauge.—A com.
1812 J. H. Brown, Romsey—Helmets, hats, caps, and similar articles

*14th June* 1869.

1813 C. Mather, Manchester—Machinery for ginning, hurring, and cleaning cotton, &c.—A com.
1814 W. R. Lake, Southampton Buildings—Sewing machines.—A com.
1815 L. H. Dennis, Birkenhead—Apparatus for cutting or dividing glass
1816 E. G. Brewer, Chancery Lane—Connecting pipes or tubes.—A com.
1817 R. Brown, Glasgow, N.B.—Manufacture of iron
1818 J. Taylor, Russell Street, Bermondsey Street—Floating and sliding top for wells, tanks, cisterns, &c.
1819 W. S. Underhill, Newport, Salop, and J. Smith, Church Aston, Edgmond, Salop—Reaping and mowing machines
1820 W. E. Newton, Chancery Lane—Attachment for and mode of actuating ships' pumps.—A com.
1821 J. Young, Houghton-le-Spring, Durham—Slide valves of steam-engines
1822 J. G. Tongue, Southampton Buildings—Shuttles for weaving.—A com.
1823 W. R. Lake, Southampton Buildings—Machines for sewing boots and shoes.—A com.
1824 D. Fitzgerald, New York, U. S. A.—Firing projectiles from a cannon or mortar which is attached to a vessel

*15th June* 1869.

1825 P. Jensen, Chiswell Street—Manufacture of glass.—A com.
1826 A. W. Moss, Nelson Square—Brims or sunshades for attaching to hats or caps
1827 F. Lejenne, Brownlow Street—Weighing machines
1828 M. Benson, Southampton Buildings—Machines for planing wood.—A com.
1829 M. Benson, Southampton Buildings—Mortising machines.—A com.
1830 M. Benson, Southampton Buildings—Band-sawing machinery.—A com.

1831 F. C. Bakewell, Hampstead—Apparatus for letter-printing.—A com.
1832 W. Smith, Bathgate, Linlithgow—Treating or purifying mineral oils
1833 J. Bastow, Shepherd's Bush—Bleaching yarns, threads, and woven fabrics
1834 J. Lindley, Clifton—Apparatus for oiling the axles of trucks or wagons used in collieries
1835 H. Bathgate, Salford—Apparatus for effecting communication between railway passengers, guards, and engine-drivers
1836 W. Yates, Manchester—Furnaces for effecting the consumption of smoke
1837 W. Bottomley, Bradford—Footsteps, steps, or bearings for the spindles and shafts of various machinery
1838 R. Beecroft, Ovenden, near Halifax—Machinery for combing wool
1839 J. Halliwell, Halifax—Holdbacks for carriages.—A com.
1840 J. T. Masbon, Paris—Apparatus for carrying invalid, wounded, sick, and other persons
1841 T. Knowles, Manchester—Doubling frames
1842 H. Tylor, Queen Street—Spring mattresses and in bedsteads
1843 C. Stuart, Manchester—Chain pulley-blocks
1844 R. McHardy, Edinburgh—Agricultural and garden implements
1845 D. Dishart, Glasgow—Sewing machines
1846 J. Tangye, Birmingham—Governors or regulators for steam-engines
1847 B. Wartski, Bethnal Green—Manufacture of waterproof overcoats &c.
1848 S. V. Fontana, Copthall Court—Harmoniums.—A com.
1849 W. R. Lake, Southampton Buildings—Producing a polished or enamelled surface upon sheet iron.—A com.

16*th June* 1869.

1850 G. W. Fox, Manchester—Treatment of castor, cod-liver, and other medicinal oils
1851 R. Hornsby and J. E. Phillips, Grantham—Reaping and mowing machines
1852 R. Hornsby and J. E. Phillips, Grantham—Hay-making and raking machines
1853 W. Woofe, Bedford—Ploughs
1854 E. Cardon, Paris—Construction of ships
1855 T. Routledge, Ford Works, near Sunderland—Preparation of materials for the manufacture of paper
1856 A. Destouy, Southampton Buildings—Apparatus for sewing boots and shoes
1857 W. E. Newton, Chancery Lane—Apparatus for cleansing and preparing rags for the manufacture of paper.—Partly a com.
1858 B. Hunt, Serle Street, Lincoln's Inn—Apparatus for ventilating and purifying rooms or apartments.—A com.
1859 C. Marlor, Denton, Lancaster—Pad for hats, caps &c.
1860 W. R. Lake, Southampton Buildings—Apparatus for counting the stitches made by a sewing machine.—A com.
1861 J. Kirk, S. Shelmerdine, and C. Froggatt, Stockport—Machinery used for felting or planking the bodies of hats or bonnets
1862 J. H. Banks, Chester—Convertible desks or benches

17*th June* 1869.

1863 J. Harding, Warrington—Mail or cash and other bags or portable receptacles
1864 W. McNabb, Clapton—Fasteners for bands
1865 J. H. Johnson, Lincoln's Inn Fields—Picks.—A com.
1866 J. H. Johnson, Lincoln's Inn Fields—Manufacture of sugar.—A com.
1867 C. and E. Brightman, Bristol—Manufacture of shoes and boots
1868 W. R. Lake, Southampton Buildings—Preparing sulphates and obtaining fine silver therefrom.—A com.
1869 W. R. Lake, Southampton Buildings—Culinary utensil to be used on stoves or ranges, for broiling, toasting, baking, &c.—A com.
1870 S. Adams, Saltley, near Birmingham—Velocipedes

18*th June* 1869.

1871 T. Bourne, Birmingham—Velocipedes
1872 J. G. Tongue, Southampton Buildings—Production of novel and ornamental effects in the manufacture of various articles of glass.—A com.
1873 I. Gregory, Manchester, and E. Ainsworth, Newton Heath—Drag motion applied to throstle frames and doubling frames used for spinning and doubling cotton &c.
1874 H. and C. F. Cockey, Frome-Selwood, Somerset—Economising the consumption of fuel used for steam-boilers and lessening the quantity of smoke
1875 J. Napier, Glasgow—Cooking ranges, stoves, and grates
1876 G. Molland, Southampton—Axle-boxes
1877 W. Topham, jun., and S. Wells, jun., Birmingham—Manufacture of the handles of kettles, &c.
1878 M. Andrew, Melbourne, Victoria—Locks and latches
1879 W. R. Lake, Southampton Buildings—Permanent way of railways.—A com.
1880 E. Haas and V. Wanostrocht, Wallbrook—Pushing jacks—A com.

19*th June* 1869.

1881 T. Silver, New York, U.S.A.—Device for holding letters, bills, and other papers. A com.
1882 J. Bullough, Accrington, and C. Catlow, Burnley—Looms
1883 S. Holmes, Rotherhithe—Binocular and stereoscopic microscopes
1884 H. A. Bonneville, Sackville Street—Compounding and applying certain componnds to render fabrics water-repellent.—A com.
1885 A. S. Harington, Saint James's Club—Pouch for tobacco
1886 H. Baucrrichter, Clerkenwell—Show-cases and fancy boxes
1887 C. E. Brooman, Fleet Street—Apparatus for ascertaining weights and strains.—A com.
1888 J. B. Brooks and G. Picken, Birmingham—Improvements in the sticks of umbrellas and in walking-sticks and whips
1889 F. Forder and J. Traves, Wolverhampton—Velocipedes
1890 E. H. C. Monckton, Threadneedle Street—Manufactnre of iron and steel
1891 S. Nicholls, Plymouth—Machinery for tilling or cultivating land
1892 R. Olpherts, Louth, Ireland—Indigo presses

21*st June* 1869.

1893 M. Olsson, Barnsbury—Preserving animal and vegetable substances.—A com.
1894 W. Pidding, Lambeth—Mechanism applicable to locomotion
1895 A. J. Glas, Bedford Street, Westminster—Decorticating, separating the germ, and drying wheat or other grain
1896 B. Bell, Regent's Park—Improvements in the mode of affixing wood and metal sheathing to iron, steel, or wooden ships, &c.
1897 A. Manbré, Baker Street—Treating cereal and other vegetable snbstances
1898 P. G. B. Westmacott, Newcastle-upon-Tyne—Hydraulic or steam cranes
1899 W. R. Lake, Southampton Buildings—Blowing and pumping engines.—A com.
1900 W. R. Lake, Southampton Buildings—Carriage wheels.—A com.
1901 T. F. Cashin and J. Green, Old Broad Street—Furnaces

22*nd June* 1869.

1902 C. D. Abel, Southampton Buildings—Machinery for opening and closing gates, doors, or barriers, and for actuating semaphore signals by means of electricity. A com.
1903 J. Martin, Leeds—Rendering cloth and other fabrics and materials repellent of water
1904 G. Musgrove, Pelton Colliery, near Chester-le Street, Durham—Apparatus for indicating signals in mines or shafts
1905 W. Clark, Gateshead, and E. Walker, London Street—Windlasses
1906 T. and R. Nuttal, Walmsley—Weaving counterpanes, quilts, &c.
1907 J. C. Norman, Great College Street, Camden Town—Plough
1908 G. M. Harris, Gloucester—Improved vice
1909 J. I. Evans, Merthyr Tydvil—Apparatus for cold rolling iron for tin plates
1910 R. R. Kelly, Manchester—Supplying furnaces with coal and other fuel
1911 W. R. Lake, Southampton Buildings—Combustible compound.—A com.
1912 M. Henry, Fleet Street—Typographical composing and printing.—A com.
1913 H. T. Munns, Birmingham—Portable sketching camera obscuras

23*rd June* 1869.

1914 R. Moreland, jnnr. and D. Thomson, Old Street, St. Luke's—Steam rollers
1915 W. Spence, Quality Court—Manufacture of sugar and alcohol.—A com.
1916 J. H. Johnson, Lincoln's Inn Fields—Injectors for feeding steam generators.—A com.
1917 D. B. Park, Fraserburgh, Aberdeen—Removing animal and vegetable deposits from the bottoms of vessels
1918 A. J. Deblon, Fives-les-Lille, France—Machines for calendering stuffs
1919 O. Zabel, Quedlinbourg, Prussia—A grease box for all sorts of pistons, slides, &c.
1920 A. M. Clark, Chancery Lane—Electric telegraph apparatus.—A com.
1921 A. M. Clark, Chancery Lane—Anti-explosive or safety lamp applicable for mining and general purposes.—A com.
1922 H. A. F. Duckham, Camden Town—Gas regulators

24*th June* 1869.

1923 R. Cannce, Mansfield, and M. G. and B. Bradley, Nottingham—Apparatus for twisting yarns and other threads of cotton, wool, silk, &c.
1924 W. W. Neame, Birchington, Kent—Fencing
1925 R. N. Williams, Hackney Road—Reflectors for artificial light
1926 S. Joy, Manchester—Apparatus for removing the dust from rag machines
1927 J. Macintosh, North Bank, Regent's Park—Waterproof varnishes and paints
1928 J. Brooke and J. Hirst, Huddersfield—Improvements in certain fabrics technically known as "paddings"
1929 J. Taylor, R. Ingham, J. Ingham, and J. Charples, Craushaw Booth, Lancaster—Carding engines
1930 R. Olpherts, Ardee, Louth—Shears and knives for reaping and pruning
1931 A. H. Still and D. Lane, Cork—Manufacture of gas
1932 W. Braccelin, Robert Street, King's Road, Chelsea—Velocipedes

25*th June* 1869.

1933 Major Palliser, Army and Navy Club, Pall Mall—Key fastenings for railway chairs
1934 W. F. Williams, Broad Street, Golden Square—Boxes for holding jewellery
1935 J. Heys, J. Duckworth, and G. Barnes, Haslingden, Lancaster—Carding engines
1936 H. Caro, Mannheim, Grand Duchy of Bade, C. Graebe, of Berlin, and C. Liebermann, Berlin—Preparing colouring matters
1937 J. Lamb, Kidderminster, Worcester—Bobbin frames for carpet looms
1938 A. B. Childs, Mark Lane—Catamenial sacks or uterine supports
1939 C. Cochrane, Upper Gornal, Stafford—Preparation of iron ores for smelting

26*th June* 1869.

1940 W. Madders, Manchester—Embroidering machines
1941 F. C. Lecoultre, Geneva—Changing the barrels of musical boxes
1942 J. Donald, Johnstone, Renfrew, N.B.—Apparatus for finishing woven fabrics
1943 J. Lomax, Hulme, Lancaster—Apparatus for arresting and depositing the "stive" or flour contained in the air discharged from millstones during the process of grinding
1944 J. Lomax, Hulme, Lancaster—Apparatus for preventing the deleterious effects of "back lash" in driving millstones
1945 F. Wohlgemuth, New York, U.S.A.—Changing a breech-loading shot gun into a breech-loading rifle
1946 A. Clark, Chancery Lane—Permanent way and rolling stock of railways.—A com.
1947 T. Gray, Union Road, New Wandsworth—Varnishes
1948 W. H. Perkin, Sudbury—Colouring matter suitable for dyeing and printing
1949 G. Fielding, Huddersfield—Smoke burner, to be adapted to the flues of steam boilers
1950 A. Bowring, Old Bond Street—Shirt collars

28*th June* 1869.

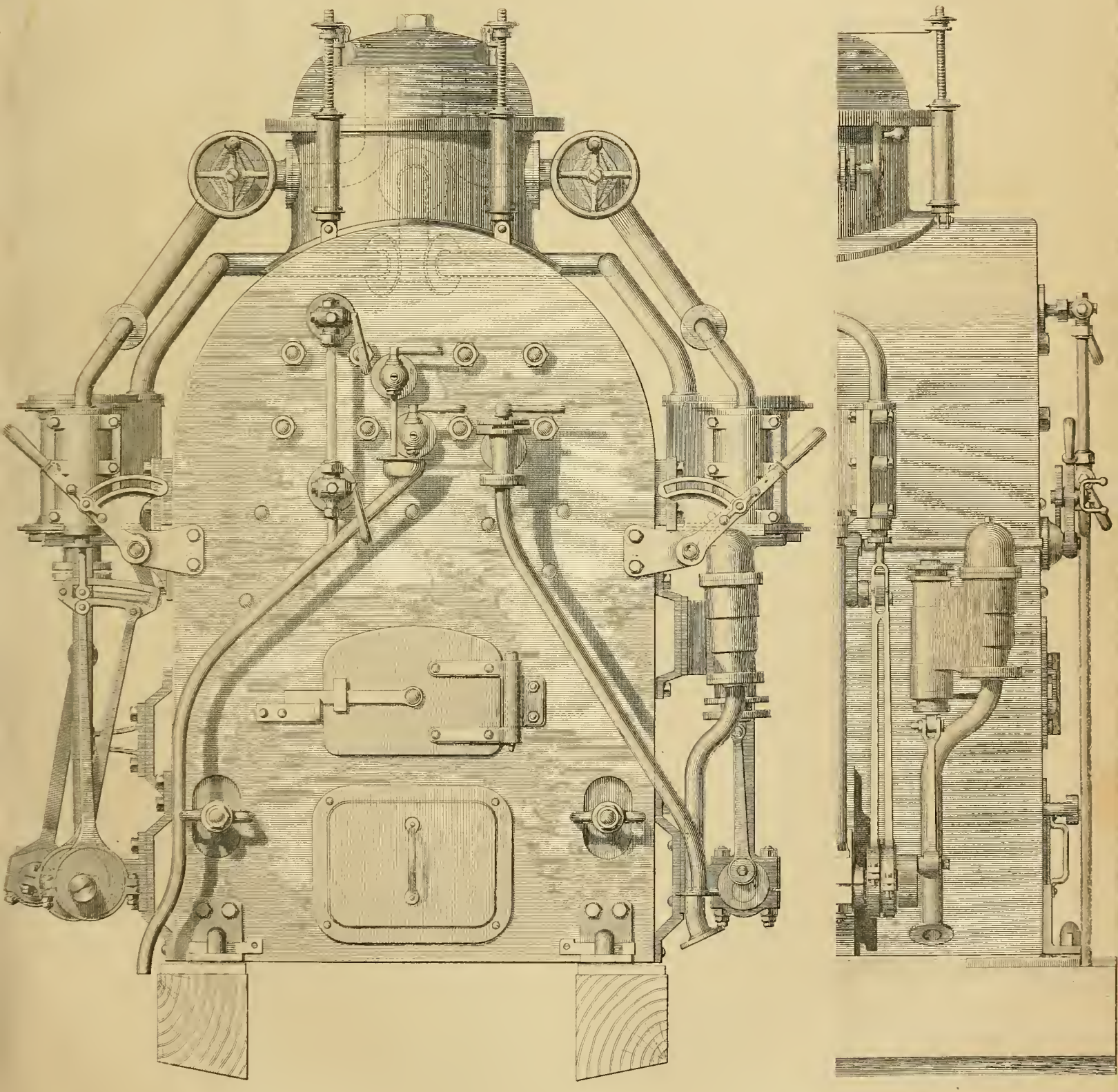
1951 W. P. Wilding, Preston—Self-acting mules employed for spinning cotton
1952 C. D. Abel, Southampton Buildings—Ventilating hat.—A com.
1953 M. Kennedy, New York, U.S.A.—Short levers weighing scales
1954 J. W. Burton, Leeds, and R. W. Morrell, Bradford—Manufacture of combined woven and felted fabrics
1955 G. T. Smith, East Retford, and C. Challenger, Retford—Composition applicable to the manufacture of floor cloths, tarpaulins, railway sheets, and other waterproof fabrics
1956 J. Howard, Bedford—Horse rakes
1957 W. R. Lake, Southamptou Buildings—Rendering and refining lard, tallow, and other fatty and oleaginous matter.—A com.

29*th June* 1869.

1958 G. C. Haswell, Edinburgh—Water directors for fire engines, garden engines, and hose, and for nozzles for force-pumps
1959 C. L. V. Yon, Paris—Portable camping trunk
1960 W. Cowan, Kittybrewster, Aberdeen, N.B.—Locomotive engines
1961 W. Blackburn, Manchester—Standards or supports for benches, desks, and tables
1962 E. T. Hughes, Chancery Lane—Manufacture of sugar.—A com.
1963 W. Bartram, Sheffield—Apparatus for filling and closing cartridges

30*th June* 1869.

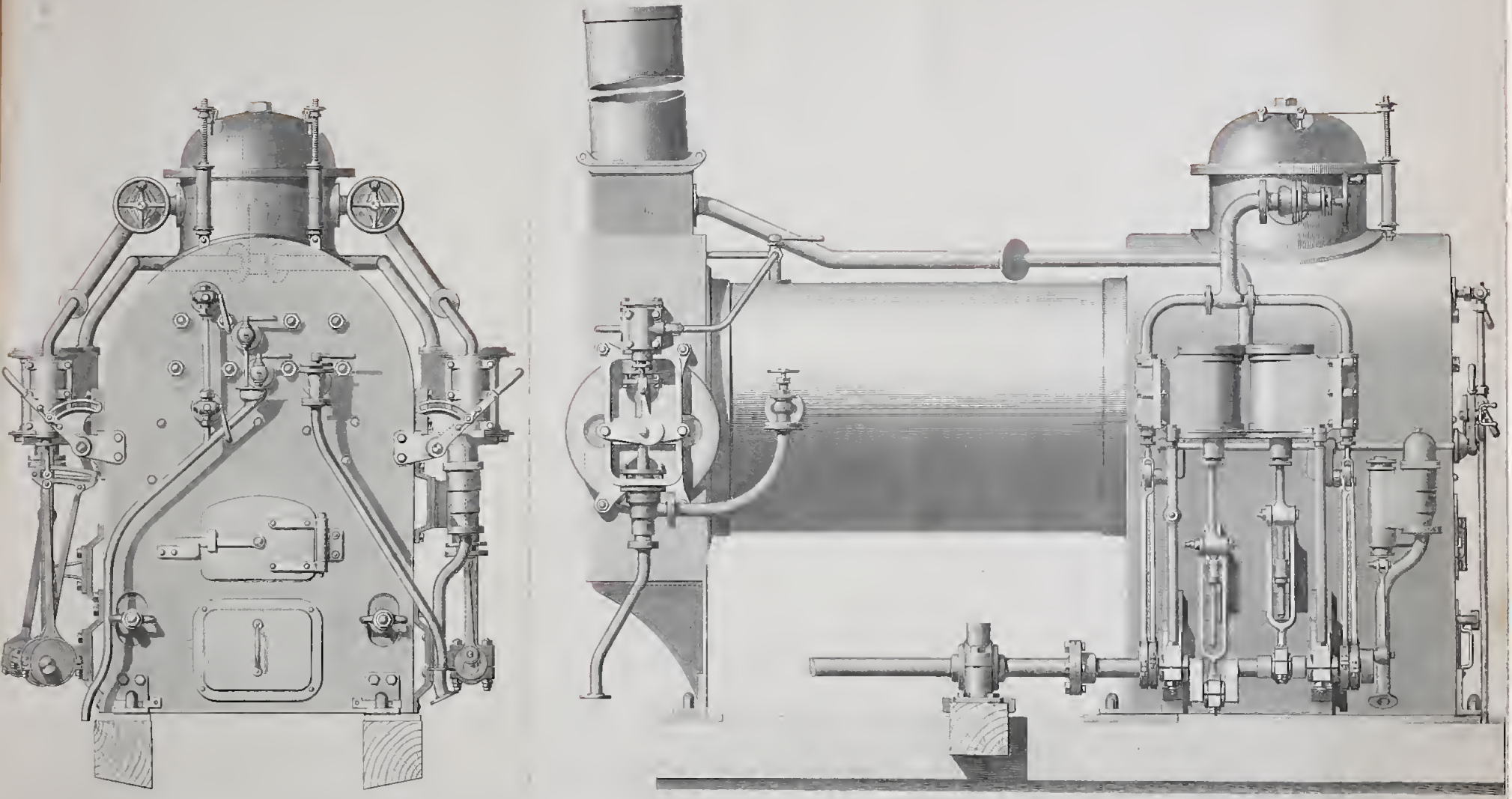
1964 H. Yates, St. Pierre les Calais—Bobbin net or twist lace machinery
1965 R. H. Courtenay, Meyrick Road, Clapham Junction—Producing printing surfaces
1966 B. Templar, Tetlow Fold, near Manchester—Combined apparatus for damping and cleaning slates, sharpening slate pencils, and wiping pens
1967 M. Turnor, Birmingham—Manufacture of metallic and other boxes
1968 R. Brown, Glasgow, N.B.—Manufacture of iron
1969 W. E. Gedge, Wellington Street, Strand—Carriage spring.—A com.
1970 W. E. Gedge, Wellington Street, Strand—The incorporation of extract of meat with all kinds of sweetmeats or comfits, with syrups or any sweet or glucose matter, with quinine wine, and all kinds of wines prepared with quinquina.—A com.
1971 D. Hebson, Liverpool—Steam engines
1972 R. Knowles and J. Lindley, Manchester—Manufacture and ornamentation of ladies' night-dress cases, bed-head bags, watch pockets, &c.
1973 R. Heyworth, Manchester—Waterclosets, wash basins, and urinals
1974 W. H. Bailey, Salford—Cutting and slicing machinery
1975 R. Boyd, Strand—Switches and signals—A com.
1976 J. Robinson, Martin's Lane—Preserving animal and vegetable substances.—A com.



# ENGINES OF STEAM LAUNCHES FOR THE ROYAL NAVY.

MAUDSLAY SONS AND FIELD
Engineers





Scale

Trotman & Co. London & Westminster

## INSTITUTION OF MECHANICAL ENGINEERS.

### The Annual Meeting, held at Newcastle-on-Tyne.

We regret that the exigencies of space in this Journal preclude our giving more than a condensed and necessarily imperfect account of the proceedings of this meeting, held on the 3rd, 4th, 5th, and 6th of August, and just concluded.

Peripatetic scientific societies have greatly multiplied in the wake of the British Association, which led the way; and each year now sees its naval architects, the social science, the medical science, its naturalists in the Ray Society, its archæologists, and several others, meeting now here, now there, if not in London. There is one peculiarity, however, in the arrangement or *ordonnance* of the great stated meetings of the mechanical engineers that distinguishes them very much, and, for the objects of the Institution very favourably, from those of any of these other bodies. Although the papers read are of a generally high class, and well chosen as to the importance of their subjects, these, on such occasions, are kept within narrow limits as to time, and so the greater portion of the whole time of meeting is enabled to be devoted to the so-called excursions; that is to say, to the well-ordered and instructive visits made to mines, collieries, manufactories, chemical works, shipyards &c. &c. There can be no better appropriation of the time; one from which far more that is new and valuable is acquired rapidly and pleasantly, than from any amount almost of descriptive-paper reading, were that dry method substituted for it.

The complete success of these visitations at the late meeting was no doubt due greatly to the energy and intelligence of Mr. W. P. Marshall, the able secretary of the Institution; but his efforts could not have produced their full effect had they not been seconded by the liberality and kindly co-operation of the great mining and manufacturing proprietors of the district, whose unreserved openness in displaying their methods, machinery, and productions merit the most ample acknowledgment.

Probably no great centre of industry amongst the many with which our islands abound presents such attractions for such a meeting as does Newcastle and the district of the Tyne around. Civil engineering in every one of its varied departments, iron and timber ship building and navigation, mechanical engineering shops of unsurpassed excellence—several with names and reputations that have passed into proverbs—producing marine and all other engines, locomotives, and the Newcastle specialty "hydraulic engines;" Elswick with its varied tasks, and more especially its heavy ordnance manufacture; chemical works of many classes, and, as regards the alkali trade, of unequalled magnitude; collieries, amongst the deepest and best wrought in the world, with pit-work above and below the surface of the newest and best types; glass manufacture—to say nothing of other manufactures, such as carpets, wire and hemp ropes, terra-cotta &c., all cluster here and literally fatigue the attention of the well-informed visitor by the mass and the variety of new information they present to him in their ever onward and improving progress.

Coal, as the material means, is no doubt at the base of all this prodigious accumulation of stirring energy and brain-directed labour; but even all the wealth in fuel of the Tyne would not present the speetacle that

"The lands by the Tyne and Wear"

show to-day, were it not for the grand elements of personal character possessed by the people: amongst those who lead and command, by knowledge, position, and wealth, an amount of information, science, practical readiness, and mercantile shrewdness unsurpassed, if equalled anywhere else in Great Britain; those who labour—a grand race, both men and women, of northern giants—certainly no finer men, no more tractable, persevering, strong-willed, and handy or skilful workmen and labourers are to be found amongst us.

The results are very grand and noble to contemplate—whether it be in the hard and mighty trunk of industrial growth in the raw material transformed by manufacture to use, or in the graceful flower, when shown in the result of wealth honourably acquired and nobly expended.

As an example of the former, we may point to the Palmer Shipbuilding Company, which presents, along its lengthy frontage of almost a mile upon the banks of the Tyne, the rare realisation of that ideal of manufacturing often talked of but seldom seen. At the eastern end may be seen the iron ores, limestones, and coal, and at the western one these are sailing or steaming away as ships. Every stage of conversion, from crude iron to marine engines and ships (to say nothing of collaterals in rails and iron bridges &c.), has taken place intermediately. Except the works of the *Société Cockerell* at Liege, we know of nothing like it; and the latter in some respects yields to these grand Tyne works.

Then, turning to an example of the latter; every British subject who had the honour of dining with Sir William Armstrong (who entertained the entire body of mechanical engineers at a princely repast in his banqueting hall at Deepdene on Wednesday evening, the 4th August) must have felt justly proud of his illustrious countryman; not alone for what he has achieved as an engineer and mechanician, but in presence of the evidences afforded by that architecturally graceful hall, and the exquisitely gardenesque grounds in which it stands, of the vein of genuine poetry which their production evidences, as part of the natures of Sir William Armstrong and his amiable wife.

Where such a mass of new or interesting matter pressed upon the attention at all sides, it is not easy to say which were to be viewed as the great lions of the time. We cannot avoid, however, classing amongst such the paper of Sir W. Armstrong, President, upon the great swing bridge over the Ouse near Goole, and of his pupil, Mr. Westmacott, on the hydraulic machinery for warehousing grain at Liverpool Docks; Captain Noble's very elegant instruments for determining the varying velocity of rifled projectiles within the chase of the gun; the revolving alkali furnace of Messrs. Allhusen; the *Duchess of Sutherland*, Holyhead and Dublin new steam-ship, by Messrs. Stephensons; the Ryhope Colliery, plant and workings; and the two grand central battery ships of war building for the Admiralty at Palmer & Co.'s yard. These are sheathed all over with teak, and that with copper; this necessitates stem and stern frames of bronze, of which, in most magnificent castings, there is said to be about 90 tons in each ship.

## HOUSE-WASHING IN PARIS AND LONDON.

Half the meanness in the public aspect of London, which, notwithstanding the evidences of enormous wealth everywhere confronting him, so strikes the foreigner—or the Englishman himself, on returning from a prolonged abode in foreign cities—arises from dirt, mere neglect and filthiness. And this is not the less a fact although we delight to designate ourselves as the cleanest people in Europe, given to much "tubbing," &c. &c. For, however clean the middle and upper ten amongst us may be in person, and as to this we need not say more than that the thick lower end of the social scale has been unmurmuringly called "the great unwashed"—we shall not venture to use a stronger word—and however the interior of our middle and upper-class dwellings may stand comparison with those of the like classes in France and Germany, it is uncontradictably a fact that the exterior of our habitations in towns, the whole general aspect, both horizontal and vertical, of our cities is in a high degree filthy. It has been said, and truly, in illustration of the carclessness as to tidiness and scrubbing in Ireland, that the people of Dublin are unconscious of their dirty windows, on which the dust and dirt accumulate often for weeks or months without removal. But the same law of inattention applies to ourselves in London, and in most large English cities and towns. We are, no doubt, by habit scrupulous about our front windows, for our servants are all drilled into hebdomadal cleanings of these, and they are punctilious as to the whiteness of their respective door-steps—that being a matter of domestic rivalry, if not of household honour and dignity—but with these the matter of rigid cleanliness very nearly comes to an end. The atmosphere over our heads is unceasingly showering down "blacks" and fine grained or impalpable ashes, unnoticed except by the unlucky optic that receives one of these floating rough fragments, and finds it cuts its way into the coats of the eye when we try to rub it out.

Now and then, in spring and autumn, the canopy of smoke and

damp watery vapour of our Thames basin comes bodily down upon our heads, and, for six or eight hours at a stretch, rests on the very pavement and takes away the light of heaven; and after one of those visitations of so-called "fog" it is easy to see, if we examine a sheet of white paper that has been exposed to it against another which has been shut up, what an amount of impalpable carbon has settled upon and clung to everything, glued to the surface, as it were, by some fat moisture descending along with it. Our streets, whether macadamized or paved, are, with brief intervals between the alternations, either sloppy with rain-made mud, or covered with dust and grit which our huffling winds stir up, and sweep in clouds over the very house-tops, and into every room and open cranny. The mud, albeit that it is only in rare instances swept up and away with the promptitude it should always be, is a direct annoyance and loss chiefly to passengers through the streets, especially those on foot. With pits in the pavement which are literally pitfalls for the unlucky crosser of a street, how often in wet weather—that is to say, throughout one half of our year—do we see one single footfall by a cab horse into one of these little Styxes bespatter from head to heel, with flint abomination, the a moment before clean and natty dress of man or woman!—an event which, in the case of the latter, often means its destruction; but whatever is left of it unscavenged is so much *pabulum* for dust when the surface dries up again.

We shall not insist upon the needless waste and expense incurred in harness and carriages, public and private, by this gritty incrustation of every day. The dust, however, is a more searching and a more universal evil, and one the supply of which is not even left to what may be called, by a grim pleasantry, its natural sources—the street surfaces.

Demolitions of buildings large or small, the removal of rubbish, and the clearing out of dust-bins, the accumulation of refuse in which at all is one of our unclean habits, are constantly going on in various directions: dry dust flies about in storms as a natural consequence. The passers-by veil their faces or shut their eyes as best they can (often at risk of limb or life in the crowded and jostling thoroughfares), but the "sand storm" is let to continue without hindrance or police interference; and, besides the personal punishment, it spreads lodges and clings right and left, going over the house-tops and into windows if open (housemaids generally prefer stifling want of ventilation to "letting in the dust and blacks"), and sticking permanently to every more or less rough vertical surface. Now, can anything be more obvious than that it should be matter of police law and practice, that every one charged with a demolition, large or small, should be compelled to keep the old material in course of dislocation, and being carted away, continually wet? One labourer with a hose-pipe from the street mains, or, failing sufficient head in some localities from these, aided by a small steam or manual pump, could sprinkle the area upon which twenty demolishers can work, and so that source of dust and discomfort would be at an end. The same rule ought to apply to every rubbish cart receiving dry rubbish from baskets &c. in a public way.

There remain, however, the street surfaces. From these the actual weight and bulk of ground-down and between-joint-forced-up material that is removed by the wind, would seem incredible were it truly stated. On London Bridge, it is said that, at a minimum, four inches in depth of solid granite pavement is ground away every half-year. Some of this is washed off the inclined surface towards both ends by heavy rain, some is carted away at night, but a very large proportion of this third of a cubic foot of stony material on every superficial foot of this area is simply raised in dust, and in clouds blown into passengers' faces, and into the river, or upon the wharves and houses adjacent. Now, a good deal of this arises from the perfect inefficiency of our system (bless the fine word!) of street-watering by contract. The contractor and his men contract their water supply to the very lowest point that will give the semblance of watering upon the arid surface. There is no one to look after the work constantly, and see that the watering is a reality, the water in volume sufficient to lay the dust, not partially or for a few moments, but for hours, or until the next turn of watering shall come. What is the result? The surfaces of the pavement are everywhere, at this season of the year, kept partially in a state between wet and dry for the larger portion of the day, and during the whole of the night not wet enough to keep down dust, and yet over an uncertain portion of the entire surface just damp enough to be at the maximum of "greasiness." Sticky and slimy, with a thin coat of dry-weather mud, here for a yard or two liquid, there for many yards as soapy and devoid of friction as though it were actual tallow, it is easy to see that this sham street-watering is the prolific cause of almost all the accidents (as they are called) of falling horses, and that an unknown but most formidable and deplorable amount of needless draught, labour, and suffering, both through constant terror and by actual strains and bruises, and a prodigious loss of actual money in wasted horseflesh, are the results.

If these be facts, and patent ones, it does strike us that our police force would be better employed in enforcing proper street-watering, or none at all until the contracts, if not now stringent, were made so, than in running after stray dogs, or in such tasks as, on five days of the week impeding the traffic and bobbing up and down that absurd pair of red arms at Westminster Bridge, under pretence of security to the valuable lives of the M.P.'s who cross that eventful locality, the valueless bodies of the lieges, on every sixth day of the week, being left to buffet through as they may.

Our business here, however, is with street management, or mismanagement, and street dust, only in so far as we wish to point out the latter as one of the sources of the external dirt of London buildings, in addition to the soot; a pretty obvious fact when stated, yet one that we do not know that we have ever yet heard formally mentioned by those who complain of the soot as the sole defiler of our buildings; and our object is to draw attention to some of the means which our orderly and reasoning neighbours, the Parisians, take to maintain the external cleanness which forms part of the charm of their beautiful city. In a word, they wash their house fronts periodically, and they do it in proper ways and by suitable apparatus, which we propose to describe.

It is quite true that house-front washing in some sort is not absolutely unknown amongst ourselves. The Mansion House and Fishmongers' Hall, and one or two other buildings, have been washed not long ago, we believe by night and by means of fire-engines worked from the street; and every one who has seen either of these buildings since their ablutions will admit the improvement in appearance; but the method is incomplete and the result equally so, and many of our older public buildings, city churches &c., would, by their indurated crust of surface grime, defy the "tubbing" powers of even Captain Shaw and the brigade, were such operations the proper employment for that somewhat costly but efficient establishment.

Those who know Paris only by a few days' sojourn in the fine spring or autumn weather, and by its most splendid quarters, generally entertain the notion that Paris is bright and clean, *because* there is no smoke and no dust, and certainly they see very little of the latter. Whatever may have been the case once, say anterior to 1840 or thereabouts, this, as respects the smoke, is very far from being true of Paris now. A very large and a constantly-increasing proportion of the whole of the fuel consumed for domestic purposes in the French capital at present is pit coal; wood fuel has become, from its enhanced and ever-growing price, the luxury of the rich, or is employed by a few trades who cannot do without it or charcoal, which is still dearer. Coal from Belgium, from England, the Pas de Calais or other parts of France, now supplies more than two-thirds the domestic consumption.

Thirty years ago there were few, almost no manufactories in Paris, employing steam power or burning mineral fuel, and metallurgic works scarcely existed in the capital. Now, if one ascends to the heights of Batignolles, or still better to the Butte de Chaumont or the summits of Montmartre, he will see such an array (not to exaggerate at all by the use of the word forest) of tall chimneys as will probably surprise him, if he should be an Englishman whose visits to Paris have been made only for pleasure and to see its ordinary "lions." Great skill and pains have been expended, and with considerable success, by French architects and engineers to improve the domestic fireplaces of Parisian houses; and they have certainly reached a point far beyond ourselves in this—that they have vastly economised the fuel necessarily consumed in open

fires as compared with our own lavish waste; and they have on the whole managed to construct fireplaces and flues that give somewhat less smoke than ours, one with another.

As regards manufacturing purposes, *fumivores* have been contrived and operative in France long before Mr. Mackinnon's Act gave the first impulse to our own so-called consumption of smoke; but the truth is, perfect freedom from smoke is not compatible with many manufacturing ends, and so the looker-on from the Butte de Chaumont will see scores of more or less dense streamers of vapour or smoke driving off from the tops of the thickly-set chimney-stalks in north-eastern Paris below him. The result of all is, not only that Parisians can no longer twit us with our monopoly of good thick yellow November smoke fogs; that by day a perceptible cloud of smoke overhangs the city, and that at night Paris may, like London during the winter half year, be recognised for miles away upon the railways by the light of the innumerable gas burners reflected from the cloudy canopy above.

Two consequences of this state of things have already made themselves apparent as respects the oolitic and cretaceous stone-buildings of Paris. The surfaces and ornamental details of these don't last as well as they once seemed to do; and they get black and dirty. The dirtiness owes something, no doubt, to dust, as above referred to in London, but less than with us; for Paris dust is white and limey. Thoroughly effective means and ample pains and supervision are employed for real—and not sham—street-watering in all the better parts and greatly frequented thoroughfares; but there are innumerable streets and passages, and even outer Boulevarts, which are never watered at all, and in which the dust is sometimes intolerable. Where they do water, however, they water well, and, what is best of all, plenty of water is let to run over the surfaces of the paved streets of heavy traffic, especially of steep acclivity, such as those about the Clichy quarter, so that greasiness upon their quartz paving-stones is almost unknown.

Probably the washing-down of houses built of calcareous stone, after the Parisian method, may not tend to preserve them the longest possible time; but they wisely determine to have their houses and street-lines clean, and to let them last as long as they may, and then rebuild them; and our view ought to be the same. There are three methods, and we may say three degrees of severity of front washing-down, employed in Paris, for all of which a most complete and simple apparatus has been devised and constructed, so that the work is done cheaply, rapidly, and by contract. These we proceed to describe. The scaffolding from which the front face of the house or other building is reached is nearly always the same, and of either one of two distinct types. It consists either of simple spars thrust out from the top windows, or over the front parapet, and balanced at the inner end, from which hang the top blocks of purchase-tackles (usually 3 and 4 sheaved), the lower blocks of which are fast to a railed-in wood gallery, of about 0·75 metres wide, and from 10 to 15 metres in length. Upon this the workmen stand, and are enabled with safety to raise and lower themselves without quitting the scaffold. Or, in another form, two lofty and stout, taper, heavy spars or masts are fixed nearly upright, but leaning towards the front, and at about the length of the wood gallery apart, the butts resting upon the curb or edge of the *trottoir*; these are secured by guy-ropes across the street and laterally; from their summits hang the top purchase-blocks, as above, the lower ones being, as before, fast to the railed-in wood swinging-gallery or scaffold, the tackle falls being brought down to a small and simple *cric*, or wheel and pinion crab purchase, secured to the butt of each upright mast. In this case, one labourer below manages the raising or lowering of the gallery at the command of those upon it, raising or lowering one end first, by say a couple of feet, and then the other to restore the level. A third more expensive and more complete form of hanging scaffolding is occasionally in use for public, or other very large and lofty buildings. For the masts above, two vertical pieces of framed horsing of the required height are substituted, the plane of each being at right angles to the face of the building. These have flanged rollers under them at the base, the planes of which are parallel to the face of the building, and they run upon rails either of wood or of iron, and so can be "pinched along" from end to end of a long building. The railed-in gallery or scaffold is hung as before, but both tackle-falls converge to a single crab-purchase barrel, which is actuated by a small locomobile engine of the coffee-pot type; this having other functions also about now to be described.

The washing is performed either by cold water, by boiling water, or by high-pressure steam and boiling water alternately; and these three methods conform to the three degrees of *severity* in washing before referred to. When, as in the first case, cold water alone is used, the latter derived from the street mains, or from the nearest street-channel hydrant, or from some temporary source, is pumped up from the level of the pavement through vulcanized india-rubber hose, and from the extremity of a bent jet-pipe, of about 2 feet in length, provided with a small and flattened adjutage, is delivered with great force right against the face of the stonework, the nose-pipe being held at about 4 to 6 inches distance from that. As the washing thus proceeds by the hands of one man, another comes after him with a second jet-pipe of less power, and by its aid and that of suitable brushes removes any fragments or whatever is detached by the first, and so completes the washing; beginning at the very top, and going steadily from end to end in horizontal courses, descending to the base.

The pump is not unfrequently a double one, made like a ship's deck pump, upon a portable base, bolted down to a surface of planking and worked by two labourers; but the more complete establishments have steam pumps attached to the engine. For the second and third sorts of washing, if pumps be employed, steam pumps are indispensable, and made with metallic valves and plungers, as pumping boiling water.

Buildings that are tolerably new or clean, or that have been already somewhat recently washed, only need washing with cold water in this way; floods of sullied water flow down the frontage, but very little stone seems to be detached by it, and with the close well-jointed stonework of modern Paris, and the good mortar, or gypsum plaster employed for jointing, very little of the pointing is washed out; any that may be, being replaced. Where the frontage is longer without washing, or is very dirty, by the grain of the stone being of a more open character, or otherwise, then boiling water, delivered just as above, is employed for the washing, the finishing off of which is sometimes done with hot, but usually with cold, water and brushes. The difference in effect between the application of cold and boiling water is very evident, and under like circumstances the latter detaches much more grains of matter from the face of the stonework.

But not unfrequently it is desired to give a completely *new* face to the stonework, either of an extraordinarily dirty building, or a very old one in progress of "restoration" or not. With us in England this is almost always done by chiselling off, by hand labour of the stone-cutter, as thin a *laminum* as may be from the stonework; a process at the moment we write in progress upon the window-dressings, and other parts, of the Westminster Hospital in Broad Sanctuary.

Those who have any eye for architectural form or beauty, know but too well what this means when it has been done, even by the most skilful and careful hands; it is, in fact, to alter the proportion of every member and moulding in an ornamented building, and often to destroy all symmetry and beauty. The French method equally effects the object, but in an immensely superior manner. It takes off a complete skin of stone from the whole exterior surface, but one of excessive tenuity as compared with the thick coat necessarily chiselled off; and if the stone itself be sound, *i.e.* not absolutely softened and decayed, it leaves the clean surface of contour absolutely parallel to the ancient one, and not perceptibly altered in proportions.

It is for this that the high-pressure steam is employed. A powerful jet is delivered from a nose-pipe, just as before described, of steam or mixed steam and boiling water, at from 70 to 100 lbs. pressure, right against one point at a time of the stonework face. The jet, striking the face with great velocity, spreads out radially from the centre point of impact for about 10 or 12 inches diameter over the stone face.

Within some such area the exterior *parietes* of the stone is rapidly heated to the temperature of the steam, while, from the imperfect conductivity of the material, the stone remains nearly cold inside.

As soon as the workman observes that upon his withdrawing the steam-jet for a few moments the face of the stone itself "smokes," *i.e.* appears to evolve some steam, he knows that he has detached by expansion the outer skin, and he moves his jet to another spot. Another workman at once follows him with a jet of water, hot or cold, and on the application of this and a few strokes of the water brush the entire old surface falls off and leaves a new and beautiful one of clean stone. The thinness of the coat, however, is such that the volume of calcareous sandy matter removed in thus renewing the entire face of a lofty four or five-storey house is wonderfully small, as we were enabled not long ago to observe in the case of certain houses thus cleansed near the Rue de Parme.

To perform this work effectually, a copious and unfailing supply of steam at the full pressure is required, and hence a tolerably large vertical or coffee-pot boiler is employed. This is generally made to drive up by its own proper steam pressure enough of boiling water mixed with the steam to keep it constantly in the state of wet steam; in fact, the boiler is kept always "priming," so to say, and so sputtering out steam and hot water together. This requires a large and constant supply of feed-water into the boiler, as well as pretty strong firing; and this supply is pumped in sometimes without any engine, by hand-wrought feed-pumps, but in the cases of more complete apparatus by the engine itself, which, besides the large feed-pump, is provided with pumps to deliver at will either cold water from the street or boiling water from the boiler.

Whether this ingenious and effective method as respects the Paris building stone, such as those of Pontoise or Caen, would prove equally effective if applied to far harder and more cohesive material, such as wrought but unpolished granite, may need experimental confirmation; but that even on this, into which soot-stain enters more irremovably than into any other material employed architecturally by us, great improvement in appearance would be produced, is highly probable. That all our Portland stone, however, would be amenable to its effects admits of little doubt; and we have a strong impression that almost all our brick-faced buildings could thus have their faces washed clean likewise; and no one can hesitate to admit the improved appearance that might thus at a very small expense be given to St. Paul's, to Westminster Abbey (towers, at least), to the dingy Horse Guards, and to numbers of our old West-end mansions, with either stone fronts or stone window-dressings &c.

The process is an extremely interesting and curious one, viewed in its minute or molecular relations. It is pretty obvious that the peeling off of the thin film or crust of these calcareous stones, though powerfully helped by the rapid expansion of the exterior face, is not wholly due to that. Every calcareous stone porous to vapour or capable of absorbing that, even though quite incapable of absorbing liquids, water &c., when exposed to the air of coal-burning cities, takes in sulphurous acid vapour and vapour of water. These, condensed in the pores of the stone (like gases in those of spongy platina or of charcoal), get converted into hydrated sulphuric acid. This, reacting upon the lime, of the pores which imprison it, produces gypsum or sulphate of lime in microscopic crystals diffused throughout the exterior stratum of the stone to a certain depth. These crystals grow and aggregate to each other, and by their enlargement help the frost in disintegrating the stone. This is, in fact, what we see going on in the stones of various parts of the Houses of Parliament, and affords the clue, as we have before now pointed out in the pages of this Journal, to all those anomalous phenomena of destruction of some and preservation of other stones, though in apparently like conditions, which have been described by the commissions appointed to report upon "the decay of the stone of the Houses of Parliament," but which apparent anomalies were never really explained in any rational manner by those gentlemen. It appears, then, highly probable that the sudden heating by steam only effects what freezing does, though in a different manner, and that both have their final effect aided by the previous formation of gypsum crystals within the exterior *couche* of the stone.

From what we have just stated as to the *nature* of the decay of calcareous stones, it is pretty obvious that the best preservative treatment for such when decaying in London must be to remove thus the exterior and already gypsum-charged coat (over which no coating of zopissa or any other nostrum can be of the slightest permanent use), and at once to saturate the pores of the clean and fresh stone with the *vapour* of some hydrocarbon, and then with a coat of liquid paraffine or other analogous body.

We commend the subject generally to our architects and builders, and to the attention of the Chief Commissioner of Works.

## STEAM LAUNCHES, PINNACES, AND CUTTERS.

(*Illustrated by Plate IX.*)

The introduction of steam launches into the Navy, which took place about five years ago, was facilitated by the circumstances that the boats then in use could with very little expense be adapted to receive engines, and that by making the latter portable they could be removed whenever desirable and applied to other purposes, leaving the boat capable of being used as before. As might be expected, therefore, most of those used at present are ordinary service launches fitted with engines, boilers &c. No alteration of form is necessary in the conversion of this latter class. The stern and rudder remain the same, the screws working on each side of the latter, and the shafts supported by brackets. The engines and boilers (which are united) are fitted compactly near the middle of the boat, and the coal-boxes and water tanks (the latter containing a supply of fresh water for the boilers) are stowed as closely round them as possible. These boats are used for fighting purposes, and are capable of working their guns when under steam or oars; and are also found very useful when used for towing purposes. Since steam launches have been found to answer so well, several steam pinnaces and cutters have been built. These have single screws, and are intended to serve as lifeboats. Unlike the launches, they are not adapted for use as rowing boats.

The first screw steam launch was engined at Portsmouth Factory in January 1863, for the use of the dockyard in carrying workmen to and from the ships afloat; and in the course of the same year two others were engined, one by Messrs. Penn, and the other by Messrs. Maudslay. As early as 1863, Sir Spenser Robinson had foreseen that they would prove successful, and in that year recommended that every ironclad should be supplied with one. At the present time there are 58 screw launches and a paddle one in the service, 13 steam pinnaces, and 6 steam cutters.

Nearly all the launches are built of wood, and the following dimensions apply, almost without exception, to them:—Length, 42 feet; breadth, 11 feet; burthen in tons, old measurement, 23 tons; draught of water about 3 feet. The average displacement when laden is from 10½ to 11 tons, but the weight of the boat itself with the fixed gear only is not usually more than from 5 to 5½ tons. The engines and boilers, chocks, coal boxes and water tanks are independent of each other, and may be removed separately; thus reducing the maximum weight to be hoisted out at one time to about 2 tons. The engines of many of these boats have developed 40 indicated horse-power, and with this power they are capable of making a speed of 8 knots. Each boat can stow from 10 to 16 cwts. of coal, and this is sufficient to last out rather more than a day when steaming at full speed. The tanks are capable of carrying from a ton to a ton and a half of fresh water for the boilers; but since salt water can be used, if necessary, the weight may be dispensed with, if the prime object, for the time, is to get the highest speed, or to carry the heaviest load possible.

The only launches which differ materially from the above description are two single-screw wood-built boats, one double-screw wood boat of 60 feet long, two double-screw boats, one of iron the other of steel, and a wood boat fitted with paddles.

The pinnaces, with one exception (which is of steel), are built of wood. They vary in size and engine-power more than the launches. In length they range from 30 to 37 feet; in breadth from 7 feet 6 inches to 8 feet 9 inches; in nominal horse-power from 2 to 6; in indicated from 13½ to 31; in speed from 6 knots to 8⅓ knots; in displacement from 3¼ to 8½ tons.

The five cutters are all built of wood. They vary in length from 26 to 28 feet, and make about 7 knots speed.

These little steamboats have, as they well deserved, met with

general favour from naval men; and this is chiefly because they combine the advantages of steam power with the general handiness of an open boat. It is now found practicable to keep up communication between ships in harbour and the shore during the roughest weather which we experience, and to transport men to and fro, whenever necessary, with comparative ease and safety. It used to be not an uncommon thing during the winter months to see the "liberty" boats filled with men, struggling for hours to reach the ship against a heavy wind and tide without making any perceptible progress, while numbers of men were sitting idle in them, for want of room to work. In fact the impossibility, from want of space, of putting enough oar-power into any sufficiently stable boat to make headway against some of the swiftest currents in our harbours in very heavy weather, has often been the cause of great inconvenience and delay in the Navy and dockyards. To compare the power of the engines with oar-power, we may take the horse-power at 40, and the number of men who could row with the force of one horse-power at 8. This would show the engines to be equal to about 320 men, or 10 times as many as could be put to the oars; and the above rate of working could be kept up all day, with a couple of men on board, at a cost of under 1*l.*, while the carrying space would be much greater than if the oars were manned and the engines out. The weight of the latter (with the necessary accompaniments) makes the steam launches, when complete, much heavier than the old ones, but when steaming the drawback of having a heavier boat is much more than compensated for by having engine-power in her.

The boats already engined in the service are appropriated as follows:—

LAUNCHES.

| | | |
|---|---|---|
| 33 | appropriated to | ships in commission. |
| 7 | „ | dockyards and factories. |
| 1 | „ | harbour service at Malta. |
| 1 | „ | surveying service. |
| 1 | „ | coastguard ditto. |
| 1 | „ | use of Controller's department. |
| 1 | lent to | Royal Engineers. |
| 6 | appropriated to | ships in reserve. |
| 8 | unappropriated. | |
| 59 | | |

PINNACES.

| | | |
|---|---|---|
| 2 | appropriated to | steam reserve. |
| 1 | „ | coastguard service. |
| 3 | „ | ships in commission. |
| 1 | „ | dockyard service. |
| 4 | „ | ships fitting and building. |
| 2 | „ | unappropriated. |
| 13 | | |

STEAM CUTTERS.

| | | |
|---|---|---|
| 4 | appropriated to | ships in commission. |
| 1 | „ | „ reserve. |
| 5 | | |

The engines supplied to some of these steam launches by Messrs. Maudslay, Sons, & Field are illustrated on Plate IX., and are a modification of those originally designed by Mr. Andrew Murray, and fitted by him into a small steam launch at Portsmouth.

They consist of two pair of small engines fixed to the sides of the square firebox of a tubular boiler of the ordinary locomotive type, and driving twin screw propellers. The cylinders are 5½ inches in diameter, with a stroke of 6 inches, working about 300 revolutions per minute. The screw propellers are four-bladed, 2 feet 6 inches in diameter, with a pitch of 3 feet 6 inches. The boilers are, as before mentioned, of the ordinary locomotive construction; the plates throughout are of the best Bowling iron, and the tubes of brass.

The firegrate is 2 feet 2 inches square, giving an area of about 4¾ square feet. There are 39 tubes 3 feet 9 inches long, with an outside diameter of 2 inches. The total heating surface of the boiler is 93½ square feet. The total weight of machinery is as follows:—

| | tons. | cwt. | qrs. | lb. |
|---|---|---|---|---|
| Engines and boiler complete, with bedplates and pipes | 2 | 0 | 2 | 7 |
| Screw machinery, viz. steam tubes, shafts, propellers, and thrust bearings | 0 | 8 | 1 | 21 |
| Coal-boxes and floor plates | 0 | 4 | 2 | 26 |
| Water in boiler | 0 | 7 | 3 | 21 |
| Total weight . . . . Tons | 3 | 1 | 2 | 19 |

The power indicated at the trials has been about 40 horses, which gives a total weight of machinery, including coal-boxes, of 172 lbs. per indicated horse-power. The launches into which these engines are fitted are 42·0 long, with a beam of 10·6. At the trials, with a mean draught of 2 feet 4 inches, the speed realised has been from 7½ to 8 knots per hour.

## POWER WITHOUT FUEL.

*An Investigation of the Means by which it may be obtained from the Heat of Natural Sources.*

By James S. Baldwin, Newark, N. J., 20th February 1869.

We are induced to reproduce (with some condensation) the matter of this pamphlet, with which we have been furnished by the author, by whom it appears to have been intended for private circulation only, not so much for anything very original that it reveals, as because it treats of a subject upon which some few have latterly got mad, in a sane and sensible spirit.

As regards the mere adaptation of liquid carbonic acid (carbonic anhydrite, as modern chemical whim makes it fashionable to call it in England), Mr. Baldwin seems in complete ignorance of what has been proposed and partly done years ago by Brunel, and subsequently by Thilorier; and in fact that carbonic acid, as a source of power, has been long a hobby with many. The only point with any pretension to novelty appears to be the combination, of heat derived from sources of sensible high temperature pre-existing in nature, with the rapidly expansible power of liquid carbonic acid. This is certainly less impracticably absurd than Mr. Ericsson's and his British trumpeters' notable scheme for bottling sunbeams, in order to raise steam for the steam-engine; a scheme which would appear to have just that sort of odd and gigantic aspect which fastens upon minds of a dreamy—though active and infirm of judgment—class.

Thus, at the *scéance* of the Academy of Sciences at Paris on the 14th December last, M. Muchotte communicated a lengthy detailed account of the experiments conducted by him, with the encouragement and probably at the cost of the Emperor, upon the production of *steam*-power—or of air-engine power—by the heat of the sun. A toy engine has, it is said, been actually worked in the Imperial presence by "the sun of Austerlitz." We hear no more of the matter, however, nor are likely to do so.

The Emperor wisely encourages and freely spends his own money to enable the promulgators of almost any project that presents even a remote possibility of coming to any useful issue, to run their crotchets to death; but this once effected, he is far too shrewd a man not to gather clearly enough the main upshot of the experiment, and to drop the impracticable, when it is shown to be so.

Sunbeams as a source of *steam*-power, or of expanded *air*-power, we believe to be utterly impracticable in any useful sense; perhaps much less so, if some cheap and abundant substance having the expansibility of liquid carbonic acid, or, even an expansibility much less, can be found. But still we hold it, that the true road is lost, if we attempt to bottle up any such widely-diffused source of natural temperature at all.

Find a suitable expansible material, whether liquid carbonic acid, liquid ammonia—by which in M. Carre's hands important results have been already secured, and much more made likely—or some other, and act upon that one, not by sunbeams, nor by hot water pumped up or self-elevated from a thousand feet deep of a well which represents a capital of 10,000*l.* or more, but by burning the very *small* quantity of some *fuel* liquid or solid, needed to effect the necessary expansion. The real residual difficulty in all these is the unmanageability of any such expansible agent.

It will be a good while before an agent that, by a change of temperature of 70° Fahr., develops a pressure of 536 lbs. on the square inch of the containing vessel, and which requires that the latter shall be safe at about one-half the common strain of fired gunpowder behind spherical projectiles, can get into safe use in any hands, or into common use at all.

If we attempt to follow the track of those who are bewitched by the spectacle of so much sunbeams going to waste, such boundless stores of cold laid up in the everlasting hills of ice and snow, such a profitless supply of hot water under our feet only wanting to be brought upstairs for use, we shall find ourselves landed ultimately amongst that same class of minds which calculate how many million tons per annum of phosphoric acid, and of all other valuable elements of manure, go down our great rivers (not even as sewage, which is another great domain of enchantment), but as natural detrital mud ; or how many tons of bullion is annually wrecked and lost in the ooze and bottom of the deep, and at once soberly set to work, by the help of some limited or other liability, to "utilise" the grand discovery.

Cannot such men see that the whole experience and every natural indication of the working world sets the other way ? that even in a region of boundless water-power it may be practically best to employ steam-power ; that huge lumps of native copper, ready smelted by nature, and only needing to be got out and reduced to pigs, actually may cost more when got out than the copper operosely smelted out of complex ores of the metal ; that nature, on her boundless scale of operation, hath much in her vast workshop, that *seems* to us to be waste and loss, that not only is not so, but is weighed and measured out in her eternal balance, and that she never intended us usefully to meddle with ; such treasures are either too wide-spread to be gathered up, or too far away, if gathered, to be of any use, in the humble view of human profit ?

There are "*suffione*" upon the shore of the Island of Vulcano, one of the Lipari Islands, the temperature of which, the writer found experimentally, was sufficient to produce steam of 60 lbs. pressure per square inch. Nothing more would be necessary there, than to dig a pit, lay common boilers into it, arch or cover them over, and let the volcanic steam and vapour surround the shells, and steam power beyond calculation in amount might be procured. What would be the use of it when got ?

It is not by trying to catch a sunbeam—to clutch a morsel of heat pre-existing sensibly in nature and part of the natural work of the cosmos, but by judiciously endeavouring to create for ourselves upon a minute scale, that same sort of play of phenomena by which in nature temperature is alternately disturbed and equilibrated, and motion produced and re-absorbed—that we shall ever solve the problem, important and possible as it certainly is, of some cheaper, more portable, and universally applicable substitute for the steam-engine.

And upon the whole we are much inclined to believe that the expansion, or production, and alternate contraction or decomposition of *vapours*, presents a more feasible region for speculating and experimenting upon this problem, than any application of such unmanageable agents as liquefied gases.

We know what a pound of volatile coal-oil can effect in horse-power when applied as fuel beneath a boiler of a steam-engine—we may suppose one the best possible for its effective combustion ; but no one as yet can say, *experimentally*, what that same pound of coal-oil reduced to vapour, mixed with the right volume of atmospheric air, and exploded in *the best possible manner* in the cylinder of an engine, like a Lenoir gas-engine, can yield in duty.

Again, we can make pyroxyline burn at any rate we please—given the maximum density which its own pressing vapour can acquire ; we know what heat that will evolve in burning, and we know what that heat will do theoretically as motion, or actually as steam power ; but no one as yet knows, *experimentally*, what horse-power per time unit can be given out by a pound of pyroxyline burnt into gases, and in relation to the total weight of the apparatus necessary for the production, as compared with that necessary for the production of an equal steam-power. These, and many other like results, can now be approximately *calculated*, but that goes here but a short way, except to indicate relative feasibility or unfeasibility.

We must, however, now let Mr. Baldwin speak for himself :—

"The original, and, for a time, the only object of this investigation, was the substitution for the steam-engine of a motor which should more efficiently utilise the heat of burning fuel. As thus conducted, it led to the invention of several plans of great apparent value, one of them nearly perfect in its physical theory ; but it eventually became apparent that, by the use of suitable means, the usual artificial source of heat might in many cases be dispensed with, and replaced by those great natural sources which everywhere exist, but have long remained unused.

But in thus presenting the partial solution of so great and difficult a problem, I feel that I have individually performed but a small part of the labour involved, for at every step that invaluable store of physical knowledge, which modern research provides, has been freely drawn upon. A just and impartial comparison of the arduous and exhaustive labours of the physicist with those of the inventor who builds upon the foundation thus prepared, most conclusively demonstrates the relative inferiority of the latter.

But in following the difficult path which the physicist has trod before him, the inventor may not only acquire that knowledge of the truth which is indispensable, but he may, if he will, feel the inspiration of that spirit of tireless enquiry, that determined unwearied faith in the resources of nature, without which the great problems of practical science had better be left untouched.

If two vessels of sufficient strength are filled with liquid carbonic acid and connected by a tube, any inequality of temperature that may be brought about, by the external application of a heating or cooling agent, will immediately be followed by the boiling of the warmer liquid, and the passage of the resulting gas to the cooler vessel, where it will be condensed to its original state. And if we interpose between the two vessels so conditioned an engine suitably constructed, the pressure on opposite sides of the piston will differ, as it does in the steam-engine, in accordance with the differing temperature of the boiler and condenser ; with this distinction, that while in the steam-engine we have only one pound per square inch available pressure for several degrees excess of heat, in the boiler over the condenser, until we reach a high temperature, carbonic acid is so volatile that we obtain several pounds for each degree of excess, in the warmer of the two vessels already described, and this too when the maximum temperature is very moderate. The results obtained by different experimenters vary somewhat as to the absolute tension at given temperatures, but there is a general agreement as to the remarkably rapid increase of pressure which attends a small increase of heat. The following pressures observed by Addams are the most moderate, and hence the least favourable to the proposed purpose, of any that have come under my notice :—

| Fahr. | Pres. per sq. inch | Fahr. | Pres. per sq. inch |
|---|---|---|---|
| 30° | 398 | 70° | 658 |
| 40 | 457 | 80 | 741 |
| 50 | 520 | 90 | 837 |
| 60 | 586 | 100 | 934 |

We here see that if one of two vessels containing liquid carbonic acid has a temperature of 70°, and the other of 80°, the available pressure against the piston will be 83 pounds per square inch. It is only necessary then to maintain the temperature of the two vessels at the points designated, and interpose an engine, together with a feed-pump to transfer the liquefied gas from the condenser to the boiler, to have the means of utilising the heat of the atmosphere, of large bodies of water, of solar radiation, and of other great natural sources.

But we are met at the outset by two formidable difficulties which must be effectually removed before our theory can be reduced to practice. They are as follows :—

1. The obstacle to the easy and rapid conduction of heat imposed by the necessary thickness of the containing vessels, coupled with the small difference in temperature existing between opposite sides of their walls. It has been demonstrated by the researches of Peclet and others, that the transmission of heat through a metallic plate is inversely as its thickness, and directly as the difference in temperature on opposite sides. In the steam-engine this difference we may assume to be 1,000° as an average, being greater in the fire-box, and less in the flues ; hence, for every unit of heat transmitted through the walls of the carbonic-acid boiler in the case already

mentioned, one hundred are transmitted in the steam-boiler, and this enormous difference must be still further increased by the disproportionate thickness of the former vessel. The difficulty is great enough, however, without this last addition, which raises the odds to about 300 to 1 against the carbonic-acid engine.

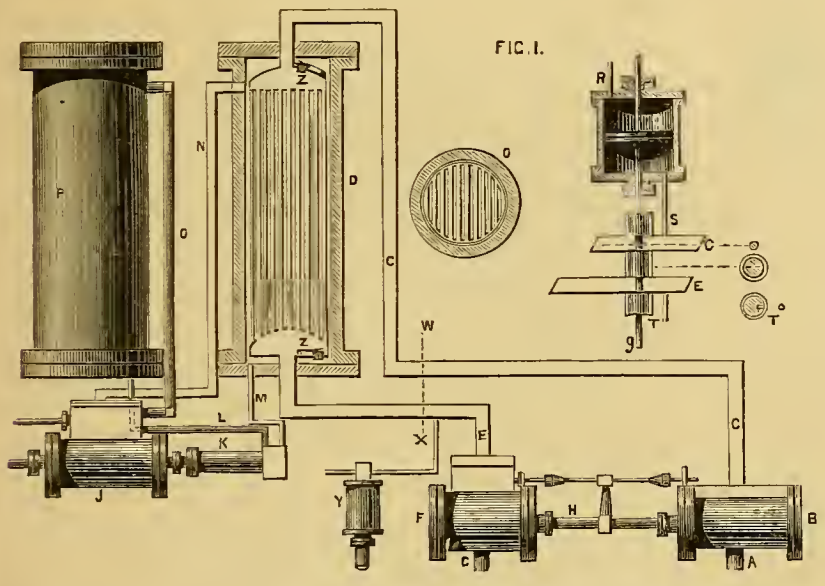
2. Carbonic acid as now prepared is an expensive gas; hence the waste and leakage, which Du Tremblay's experiments with ether have shown to be practically unavoidable in such cases, would neutralise the saving in fuel.

These difficulties may be overcome as follows, each being considered separately:—

It is obvious that, if the pressure on one side of a sheet of metal is balanced by an equivalent pressure against the other side, we may safely use a very thin plate or tube, in the presence of a substance having a very high tension. Applying this principle to the present case, if we impart or abstract heat from the carbonic acid, through the medium of a circulating liquid of the proper temperature, maintained at a tension within the tubes of the boiler and condenser equal to the pressure of the carbonic acid outside, then the thickness of the tubes may be reduced almost indefinitely, until we may regard the circulating liquid as being in contact with the substance to be heated or cooled.

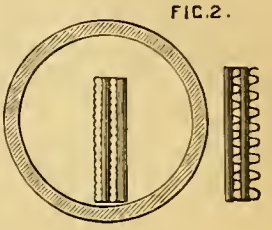
In the annexed drawings the means of accomplishing the result are shown in detail. D in fig. 1 is the boiler; the tubes are flattened, to increase the available surface within a given space. The circulating liquid is drawn through the pipe A from any suitable reservoir, and is forced into the boiler by the double-acting pump B through the pipe C C, emerging through E and entering the motor cylinder F, where it yields up an amount of power nearly equal to that required to operate the pump B. The deficiency arises from its contraction during its passage through the boiler, and from the friction of moving parts; accordingly the cylinder F is made a little larger than B, and an additional quantity of liquid is supplied by the small pump Y, which is operated by the engine, of which only a portion is shown at J: G is the waste-pipe. The valve motion of the motor cylinder is similar to that of an ordinary steam-pump, and the circulatory apparatus thus becomes self-acting and automatic. The vaporised carbonic acid passes to the engine through the pipe N, and enters the condenser P through the exhaust-pipe O. The accessory apparatus of the condenser, being the same as that of the boiler, is not represented. The condensed gas passes through L to the feed-pump K, the plunger of which is a continuation of the piston-rod of the engine, and is returned to the boiler through M.

FIG. 1.




The thinness of the tubes renders it necessary that the equilibrium of pressure shall be maintained under all circumstances. This is readily accomplished by the use of a simple regulator. A cylinder is fitted with a piston moving freely: the piston-rod runs through both ends, and in actual use its axis would coincide with the line W X. The device is shown detached for convenience of illustration; C and E have already been described. The upper end of the cylinder communicates by the pipe R, within the space in the boiler outside the tubes; the under side of the cylinder is connected with C by the pipe S; the pressure against opposite sides of the piston must therefore coincide with that against corresponding sides of the tube walls, and any slight irregularity will be compensated by its movements, whose amplitude will conform to the requirements of the case: an extended movement, however, brings into play the piston-valves attached to the piston-rod as shown, and closes the passage through the pipes C and E. If the excess of pressure is outside the boiler tubes, the liquid thus shut in being incompressible, effectually resists it, and equilibrium is speedily restored by the action of the engine drawing off the carbonic acid, and by the action of the pump Y constantly forcing in liquid. If the excess is inside the tubes, the upward movement of the piston, closing the passage through C and E, prevents any damage, while at the same time a relief channel is opened through the lower valve T, and the tension relieved by the escape of a portion of the liquid. The rod *g*, prolonged, is attached to any suitable device for stopping and starting the pump Y, or for diminishing or increasing its speed. It is not necessary to particularly describe this last apparatus, as it is now in use in an endless variety of forms: it should be so adjusted that the action of the pump will be diminished or stopped, after the relief channel in T is fairly open, and re-established before it is quite closed. The relief valves Z Z, kept in place by light springs, come in play in unusual and extraordinary cases.

FIG. 2.



To enable the tubes to resist the slight variations in pressure arising from differences in the hydrostatic level, the friction of the regulator &c., the sheets of metal of which the tubes are formed can be corrugated longitudinally, before they are bent into shape, plates of corrugated iron being introduced between adjacent tubes, of which two thus arranged are shown in fig. 2, in their proper position in a horizontal boiler; in a vertical boiler the intermediate plates should have their corrugations inclined, to permit a free circulation of the liquid.

Fig. 5 represents a different and somewhat simpler form of the equalising device. The reservoir in the top of the boiler is pro-vided with a float, which controls the ingress and egress of the circulating liquid, by the slide-valves A and B. The check-valve D prevents any reflex movement through the pipe C. It is apparent that the level of the liquid can never vary beyond the limits fixed by the adjustment of the float and its valves, and, if we except the small amount due to hydrostatic pressure, the pressure against opposite sides of the tubes must in every case be invariably the same. It is not essential that the valves A and B shall have the precise form shown, but simply that two balanced valves shall be so connected with the float F that the rise of the latter above its normal level will close A, leaving B open, and its descent shall close B, leaving A open.

If this plan were employed, however, in the vessel P, fig. 1, the carbonic acid would have a tendency to condense on the surface of the liquid. A bellows shown by the outline, fig. 5, could in this case be substituted for the float.

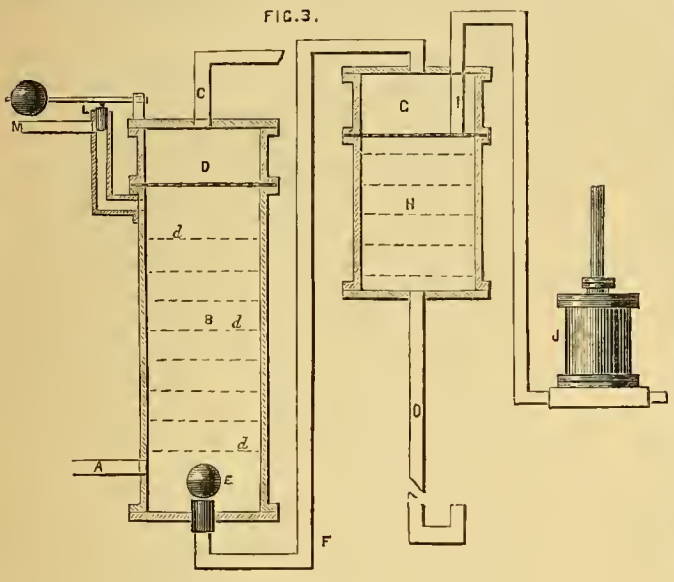
The circulating liquid should be an oil or some other substance that will not absorb carbonic acid.

Having thus disposed of the thermal difficulties, we have next to provide an abundant and inexpensive supply of carbonic acid.

Fig. 3 represents a device which may be regarded as a species of sieve, by whose aid mixtures of gases can be separated into their

elementary parts. Its operations are based upon the unequal solvent powers of water upon different gases. It consists of the vessel B, of sufficient strength to resist a pressure of from ten to fifteen atmospheres. D is a tank, supplied by a force-pump through C, from which a constant shower of water descends; this is broken into spray by the diaphragms *d d d*, of wire guaze. The mixture to be operated upon is forced in through the pipe A, and meeting the extended surface offered by the spray, each gas is taken up in accordance with the product of its co-efficient of absorption multiplied by its individual pressure. If atmospheric air were under treatment, inasmuch as the co-efficient of oxygen is more than twice as great as that of nitrogen, then while air—in round numbers—consists of five volumes of nitrogen to one of oxygen, the compound held in solution would consist of five volumes of nitrogen to two of oxygen. The water with its charge of gas accumulates in the lower part of B, and raising the float E,

FIG. 3.




opens a balance-valve, preferably of the kind known as Hornblower's, and passes through the pipe F to the tank G, from which it showers down through the partially exhausted chamber H, where it is again broken into spray by wire-guaze diaphragms, as in the preceding case, and yields up its gases, which are removed by the pump J, and transferred through the pipe at bottom thereof to any desired point. By collecting a sufficient quantity of this mixture and again passing it through the apparatus, the preponderance of the more soluble gas will increase with each operation in a geometrical ratio, until it becomes practically pure. For obvious reasons the amount of gas passed through B must be in excess of that disengaged in H, otherwise the aggregate volume of the latter will have a composition identical with the former, although the more soluble will preponderate in the first portions passed over. The undissolved gases escape through the valve L, which is loaded to any required degree, and pass through M to an engine, where they furnish by their pressure a considerable proportion of the power required to force in an equivalent volume through A. The water, during its passage from B to G, may perform an equivalent duty, by the use of a pumping apparatus similar to that shown in fig. 1. The consumption of power is therefore much less than would at first sight seem necessary. The waste pipe O has a length proportioned to the vacuum in H.

It is obvious that this apparatus must prove of great utility in the arts, enabling us, as it will, to procure with ease several gases whose present preparation is laborious and expensive. But, without dwelling upon this point, its advantages in the present case are apparent, when we consider that every fire supplied with a carbonaceous fuel, constantly gives off a mixture containing a considerable proportion of carbonic acid, whose co-efficient of absorption is at ordinary temperatures sixty times that of nitrogen. It could therefore be obtained nearly pure by a single passage through the machine, and a second would practically eliminate its less soluble associates. When, however, as will usually be the case, the fuel employed is a coal containing sulphur, sulphurous acid will be present in notable quantity. By condensing this mixture to a liquid, the carbonic acid can be separated by simple decantation. The extensive experiments of Addams in decanting liquid carbonic acid from an aqueous solution of the materials used in its manufacture, have demonstrated the entire practicability of such a plan. It is desirable that the whole process shall be purely mechanical in its character, that it may be conducted by an ordinary workman. By employing a fuel containing no sulphur, the presence of sulphurous acid may be avoided, but when the introduction of the new motor has become sufficiently extensive, a single establishment, using the waste gases of a limekiln or blast furnace, can supply the engines of a large district at a very low rate.

Reference has been made to the natural sources of heat which are available for the purpose under consideration, but before examining them at length we may notice the very extensive artificial source offered by the escaping gases of blast furnaces, brick and pottery kilns, gas retort furnaces, puddling, heating, melting, and converting furnaces, in iron and steel works &c. The minimum temperature of these products of combustion is seldom less than 300° Fahr., even where the regenerative principle is applied, and is usually very much higher. The principal points to be kept in view in this connection are, the necessity of maintaining the draught unimpaired, which can be accomplished by the use of exhausting fans, and of leaving the gases warm enough to secure their gradual ascent and dispersion.

A large amount of heat can be obtained from the exhaust of steam-engines, and the utility of its application to the carbonic-acid engine is too apparent to require further comment.

The most important natural source of heat is the atmosphere, which during the greater part of the year has a temperature much higher than that of large bodies of water, and also much higher than that of water exposing a large evaporative surface to a brisk current of air, although the results thus obtained would vary with the hygrometric condition of the latter. The diurnal variation in the temperature of the air may be employed to furnish both heat and cold, using the latter term in its relative sense, either of which can be stored in a body of water of suitable size, although this would require considerable space. A cube of water, ten feet on a side, weighing 62,000 lbs., will take up the available heat of six pounds of good coal for every degree its temperature is raised. A careful examination and comparison of the meteorological statistics of any district will readily enable us to determine what use can be made of the atmosphere.

The heat of the sun may in some cases be directly employed. The plan invented by Herschel, and put in practice by him at the Cape of Good Hope, will probably never be surpassed as a device for concentrating the heat of solar radiation. It is an admirable adaptation of well-established laws to a definite purpose. It is doubtful, however, whether its use will ever become extensive, for, aside from its uncertainty and the large amount of space necessarily occupied by the absorbing surfaces, the same expenditure of money will produce better results if differently applied. Fig. 4 represents a simple method of mounting the absorbing surface, which, having a free motion about both a horizontal and a vertical axis, can easily be kept normal to the sun's rays. An automatic regulator could easily be applied.* A current of air moved by a fan and introduced through concentric tubes at the middle of the turn-table, would probably afford the best means of transferring the heat to any desired point, and the plan previously mentioned would render its storage easy. In general terms it may be assumed that solar heat will be used only in the absence of a better source. The enlarged section shows the use of treble glass and a non-conductor, to prevent any loss of heat by convection.

The water obtained from deep Artesian wells is much warmer than that obtained near the surface. At the great well of Grenelle,

* Since the above has been in type, and the lithograph has been prepared, I have learned that the apparatus, with which Ericsson is now experimenting upon solar heat in Sweden, is mounted in a manner similar to that described above, but is more complex in its details.

aud at many others of approximate depth, a difference of from 40° to 70° Fahr. must exist during the winter months between the temperature of the water and that of the atmosphere: a large amount of power could be obtained from this source during the cold season, the engines being driven by the heat of the atmosphere during the summer. The saue holds true of the water of deep mines, which might in many cases assist in raising itself.

In its economy of construction and repair, the carbonic-acid engine will possess several advantages over the steam-engine, advantages which will go far towards compensating for the increased expense involved by the high pressure employed. These advantages are due mainly to the employment of a low temperature, which enables us to use a fusible solder in making all interior joints and fittings; thus affording great facilities for changing the number and position of tubes &c., aside from the rapidity and ease with which new work can be put together. We may also employ leather, both for packing moving parts and for valve seats. Recent experiments have shown that the friction of the leather packing used in hydraulic presses consumes only 1-200 of the power expended.

FIG. 4.

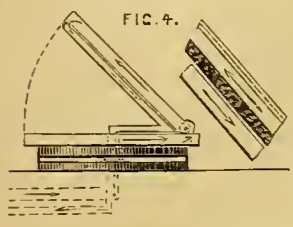
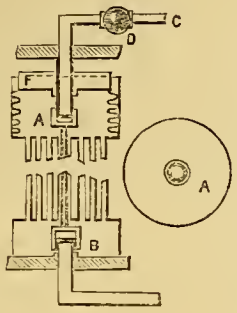


FIG. 5.




Another very great advantage will consist in the absence of that excessive and irregular expansion which gives so much trouble in the steam-engine.

The question of constructing a boiler capable of sustaining a constant pressure of nearly or quite 1,000 lbs. per square inch is one which has been practically solved by recent improvements in the manufacture and working of mild steel. There does not appear to be any good reason for giving the boilers a greater diameter than 10 inches. Steam boilers on Western river boats have been safely worked for years at a pressure of from 200 to 220 lbs. per square inch, the diameter being 40 inches and the thickness 1-4. We may infer, then, that a seamless steel tube, 10 inches in diameter and half an inch thick, will be comparatively safe. When a tube of any homogeneous soft metal gives way, it does not fly in pieces, but gradually bulges out and parts with a long slit-like opening. Absolute safety could probably be ensured by encasing the boiler with a number of stout rings, of cast or wrought-iron, fitting quite loosely; these would receive no strain until the boiler failed, and would then simply confine the effects of the rupture to those of a large leak. When this plan cannot be applied, the same result can be attained by winding-on several layers of wire. The whole subject may, however, be safely left in the hands of those who have carefully investigated it for other purposes.

The experiments of Mr. Gore have shown that liquid carbonic acid is singularly inert in the presence of metals, and the danger to be apprehended from corrosion is probably not very great. Care should be taken to exclude water and its vapour from the machine, which can easily be done.

A difference of 10° Fahr. has been assumed to be enough to secure an efficient working pressure between the boiler and condenser, but a much smaller difference than this will doubtless be employed in time. It should be borne in mind that in working with liquids of varying temperature, the entire difference cannot be utilised; we must subtract from the maximum temperature of our source of heat the maximum temperature to be maintained in the boiler, and not that of the condenser. For instance, in the case already mentioned, the water of the Artesian well of Grenelle may in winter be about 40° above the temperature of the air, but if the boiler is 10° warmer than the condenser, we can only utilise 30°. In dealing with boundless natural sources, this point will not involve any difficulty, but it must not be overlooked in designing the machine.

The opinion has already been advanced that the boiler and condenser should not exceed 10 inches in diameter. This being the case, the necessity would arise for employing a large number of such units, as in the safety steam-boilers now in use; hence great facilities would be offered for adapting the machine to varying circumstances, sections being added or detached as might be necessary.

Probably the best circulating liquids that could be employed would be glycerine, or a hydro-carbon lubricating oil having a high boiling point. There is, however, an extended variety of liquids from which we may choose. Water, from its high specific heat, would answer the purpose admirably, were it not for its solvent power upon carbonic acid. A minute leak in any of the tubes would allow but little carbonic acid to escape if oil were used, owing to the equality of pressure maintained; but if water were the circulating liquid the carbonic acid would rapidly dissolve; and thus charged, the water would gradually eat through the tubes, by constantly removing the thin film of oxide which forms when copper is immersed in that liquid. Time may prove this objection to be without any practical foundation, or it may be removed by a suitable coating applied to the tubes—tin or zinc might answer the purpose; meanwhile, it would be better to use a liquid which possesses no objectionable qualities. The use of water would also be inadmissible when, as must very often be the case, the minimum temperature is below its freezing-point.

On shipboard, the carbonic-acid engine will hardly be employed at first, as the only source of power; but, as a supplementary addition to the steam-engine, utilising the heat that is now lost in the condenser, it will prove valuable. As an auxiliary power in a ship propelled mainly by its sails, it may possibly meet with an extended field of usefulness, especially in tropical regions. No storage would be required for coals, no firemen would be necessary, and the cook's galley would supply a sufficient quantity of carbonic acid to make good all loss from leakage; while the boilers, owing to their comparatively low temperature, might be placed in parts of the vessel from which the heat of steam-boilers would necessarily exclude them.

It is needless, however, to dwell at this time upon the practical application of a machine which must undergo the ordeal of daily use, under favourable conditions, before it can be employed under those which are more difficult. Should such a test prove it to possess a basis of real merit, there are not wanting those who will carry it forward to the fullest extent. With the engineering profession in its present condition, there exists a deficiency of work to be done, rather than of the ability and disposition to undertake it.

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The following suggestions, Mr. Baldwin says (we do not endorse him), may prove useful to those who shall engage in the task of applying the new motor to practical purposes:

1. The greater the power of the engine the greater will be the economy, both of its construction and operation. Recent experiments in Switzerland, which have, as is well known, expanded into a well-established business, demonstrate the entire practicability of transmitting and distributing power over a large district; hence we may place the engine in a suburban region where space can be cheaply obtained, and transfer the power to any desired number of points, within a manufacturing town. When the problem of distributing power is fairly brought before the engineering world, it will receive a variety of solutions, each of which will probably possess some intrinsic value, though it may embody no startling novelty; and by combining the united results thus obtained, all difficulties will rapidly disappear. If we can thus place the engine in any convenient locality, increased facilities will be afforded for the use of solar heat, and for the erection of tanks for the storage of heat.

2. In any region where the winters are sufficiently cold, an ice-house of any convenient size can be filled with a solid block of ice, by showering in water, which will freeze as it falls. This plan is now practically applied in some cases: the difficulty of dividing such a mass into regular blocks, owing to the absence of cleavage, alone prevents its universal use. Such a mass of ice, costing a mere trifle, would prove useful in summer during long storms, its cold being transferred to the point of application by a stream of water, which is allowed to flow over it.

3. A sufficient difference of temperature to operate the engine can be obtained

in some cases by taking water from different levels in a deep lake. A very abundant source of heat may be found in thermal springs, such as the Solfatara in Italy.

4. There are many engineering works which can be successfully carried out whenever the power which they require can be obtained at a rate sufficiently low. The pneumatic railway, and many drainage and irrigation works, are of this character. In tropical regions an irrigating canal could be carried over a succession of hills, where the expense of cutting through them would be fatal to the enterprise; while at present the great cost of coal in such localities renders extensive pumping operations equally inadmissible. When the attention of practical investigators is fairly directed to the question of economy of repairs and construction, rather than to that of the economy of fuel, we my expect the wear-and-tear account of engines to be reduced to a very moderate amount. If the results obtained in this direction in special cases could become universal, we might expect the employment of motive power to increase with a rapidity hitherto unparalleled.

## INTERNATIONAL EXHIBITION FOR 1871.

Her Majesty's Commissioners for the Exhibition of 1851 announce that the first of a series of annual international exhibitions of selected works of fine and industrial art will be opened in London, at South Kensington, on Monday, the 1st May 1871, and be closed on Saturday, the 30th September 1871. The exhibitions will take place in permanent buildings, about to be erected, adjoining the arcades of the Royal Horticultural Gardens. The productions of all nations will be admitted, subject to obtaining the certificate of competent judges that they are of sufficient excellence to be worthy of exhibition. The objects in the first exhibition will consist of the following classes, for each of which will be appointed a reporter and a separate committee :—

I. Fine Arts.—1. Painting of all kinds, in oil, water colours, enamel, porcelain, &c.; 2. Sculpture in marble, wood, stone, terra-cotta, metal, ivory, and other materials; 3. Engravings, lithography, photography, &c.; 4. Architectural designs and models; 5. Tapestries, embroideries, lace, &c., shown for their fine art and not as manufactures; 6. Designs for all kinds of decorative manufactures; 7. Copies of ancient pictures, enamels, reproductions in plaster, electrotypes of fine ancient works of art, &c.—II. Scientific inventions and new discoveries of all kinds.—III. Manufactures—*a*. Pottery of all kinds, including that used in building, viz. earthenware, stoneware, porcelain, Parian, &c., with machinery and processes for the preparation of such manufactures; *b*. Wool and worsted fabrics, with the raw produce and machinery for manufactures in the same; *c*. Educational—1. School-buildings, fittings, furniture, &c.; 2. Books, maps, globes, &c.; 3. Appliances for physical training, including toys and games; 4. Specimens and illustrations of modes of teaching fine art, natural history, and physical science.—IV. Horticulture—International exhibitions of new and rare plants, and of fruits, vegetables, flowers and plants showing specialities of cultivation will be held by the Royal Horticultural Society in conjunction with the above exhibitions. In Classes II. and III. producers will be permitted to send one specimen of every kind of object they manufacture, such object being distinguished for novelty or excellence. Detailed rules applicable for each of the above classes, and lists of the separate trades engaged in the production of objects of manufacture, will be issued. Special rules for horticultural exhibitions will be issued by the Royal Horticultural Society. The arrangement of the objects will be according to classes and not nationalities, as in former international exhibitions. One third portion of the whole available space will be assigned absolutely to foreign exhibitors, who must obtain certificates for the admission of their objects from their respective Governments. Foreign countries will appoint their own judges. The remaining two-thirds of the space will be filled by objects produced either in the United Kingdom, or, if produced abroad, sent direct to the building for inspection and approval of judges selected for the British exhibitors. Objects not accepted for exhibition must be removed according to the notices given, but no objects exhibited can be removed until the close of the exhibition. All exhibitors or their agents must deliver at the building, into the charge of the proper officers, the objects unpacked and ready for immediate exhibition, and free of all charges for carriage &c. Her Majesty's Commissioners will find large glass cases, stands, and fittings, free of cost to the exhibitors, and, except in the case of machinery, carry out the arrangement of the objects by their own officers. Her Majesty's Commissioners will take the greatest possible care of all objects, but they will not hold themselves responsible for loss or damage of any kind. Prices may be attached to the objects, and exhibitors will be encouraged to state their prices. Agents will be appointed to attend to the interests of exhibitors. Every object must be accompanied with a descriptive label, stating the special reason, whether of excellence, novelty, or cheapness &c., why it is offered for exhibition. Due notice will be given of the days for receiving each class of objects; and to enable the arrangements to be carried into effect, strict punctuality will be required from all exhibitors, both foreign and British. Objects delivered after the days appointed for their reception cannot be received. Reports of each class of objects will be prepared immediately after the opening, and will be published before the 1st June 1871. Each foreign country will be free to accredit an official reporter for every class in which objects made in such country are exhibited for the purpose of joining in the reports. There will be no prizes, but a certificate of having obtained the distinction of admission to the exhibition will be given to each exhibitor. A catalogue will be published in the English language, but every foreign country will be free to publish a catalogue in its own language if it think fit.

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## RECENT PATENTS.

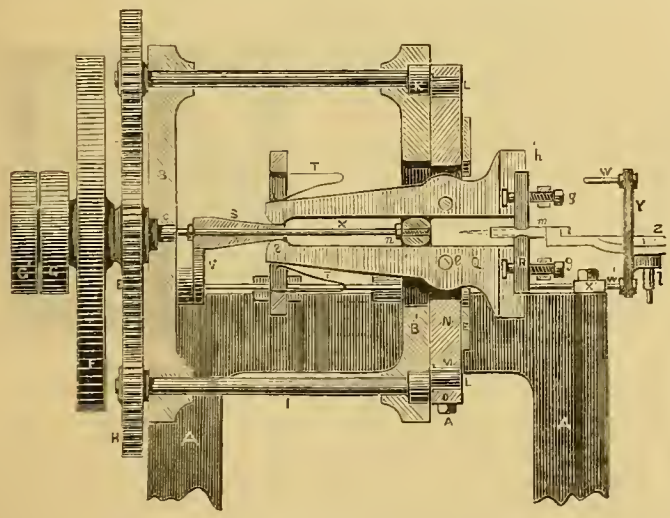
### FORGING AND SHAPING METALS.

Bernard Peard Walker, *Wolverhampton.—Patent dated November 13, 1868.*

This invention consists in the application of a copying principle to forging machines, such as those known as Ryder's Forging Machines, or modifications thereof, thereby enabling copies of a model or pattern to be produced by dies or hammer faces which need not be, as is the case in the ordinary and well-known process of stamping, the counterpart of the article to be produced. According to one mode of carrying out the invention a "bolt" or "ram" is employed driven by a crank shaft and fly-wheel, as in the well-known Ryder machine; but in lieu of attaching a swage or die immediately to the lower end of the "bolt," a lever is attached thereto, having its fulcrum at one end, and a hammer face at the other, whilst it is attached to the "bolt" or "ram" at a point intermediate between the hammer face and fulcrum by a cross pin or suitable joint, so that the hammer face has a greater amount of motion than the ram. The fulcrum end of the lever rests upon a model or pattern consisting of a piece of steel or other material which is moveable, and is shaped in accordance with the article to be produced. It will be evident that, as the lower end of the "ram" always descends to a given point, the hammer face attached to the lever will also travel when set in motion by a crank or "cam" to a given distance from the anvil (or opposite hammer face when two hammers are used) opposed, so long as the fulcrum remains stationary; but, when the fulcrum is raised, the hammer face will travel or approach proportionately nearer to the anvil or opposite hammer face. By attaching the moveable piece or pattern on which the fulcrum of the hammer lever rests to the piece

of material to be operated upon, it will be evident that the line produced by the indents given to the material by the hammer face or faces will be a copy of the contour of the moveable piece or pattern; therefore, by connecting the pattern or model with the piece of material to be fashioned, so that the two move together longitudinally, the sectional contour of the pattern or model in a plane perpendicular to the path of the hammer will be copied in the material. When using a pair of levers, the pattern or model is interposed between their fulcra, and for some special purposes two or more pairs of hammers or levers may be employed, one pair acting at any convenient angle to the other, whilst their fulcra rest against both sides of the pattern or model. The invention is obviously applicable to a very great variety of manufactures, among which may be mentioned nails, spikes, screw-bolts, edge tools, and such like articles.

The annexed engraving represents a sectional elevation of the improved forging machine constructed with two pairs of forging hammers, the one pair working at right angles to the other. A A represent the upper parts of two standards, upon which are mounted the two cruciform cast-iron or other metal frames B B′, each of which has two lugs cast thereon for the facility of bolting them to the tops of the standards. In the centre of the rear frame B there is secured, in any convenient manner, a stud or pin C, upon which is mounted so as to turn freely a hollow axis. This axis has keyed upon it a spur wheel E, the fly wheel F, and the fast-driving pulley G; the loose pulley $G^1$ being simply mounted upon the protruding end of the stud or pin C. The central spur wheel gears into four other spur wheels H, mounted



respectively upon the rear ends of the four crank shafts I, which work in holes drilled in the outer ends of the four arms of the frames B B′, and thereby impart a simultaneous rotatory motion to the several crank shafts. On the front end of each crank shaft (which the patentee prefers to make of steel) he forms an enlarged boss K, having a crank pin L formed thereon. This crank pin works in a brass or gun-metal slide block M provided with a flange on the top and bottom at its inner side, which flanges serve to guide it in its to and fro sliding motion (produced by the revolution of the crank pin) along the top of the sliding ram or bolt N; the block M being held in position by the cross bar O secured to the outer end of the ram by two screws *a* passing through hollow intermediate pieces. The several rams slide in contact with the front faces of the four arms of the front frame B′ against which they are held by cover plates, each secured by screws and steady pins to the frame B′. The lower end of each ram is forked so as to embrace the corresponding hammer lever Q, to which it is jointed by the pin *e*. Four of these levers are combined in the machine, each connected in the same way with its ram. To the outer or free end of each of the levers Q there is secured a hammer R, in any convenient manner which will admit of its being readily removed and replaced. The patentee also employs a T-headed clamp, the head of which fits into a correspondingly shaped slot made transversely across the front end of the lever, which is strengthened for the purpose. In this clamp a slot is formed, through which the shank of the hammer passes, such shank being firmly held in its place by a pinching screw *g* inserted through the front end of the clamp, the pressure of the screw tending to hold the hammer firmly against the face of the lever. In order to prevent the action of the blows from displacing the hammers, he makes a projection *h* on the outer part of the front of the lever, against which the outer ends of the hammers abut. The levers Q pass through slots or openings made for that purpose in the frame B′, and their rear ends, which may be rounded as shown, bear upon the opposite sides of a pattern or model S; the necessary contact being maintained by bent or helical springs T contained in a supplementary cross frame as shown, which extends between and is secured to the standards or supports, slots being made in such frame for the reception of the said springs and the rear ends of the hammer levers. The model itself is composed of cast or wrought metal, and is secured firmly to, or cast in one piece with, a bridge piece V, which connects the two rear ends of the parallel sliding rods W W′ working along and in guides at X and X′. The front ends of these rods are extended some distance beyond the hammers, and are connected by another bridge piece Y, thus forming a sliding frame. This sliding frame is guided by causing the model on the one hand to slide along the fixed rod X secured by the nut *n* between the two frames B B′, whilst on the other hand the lower one W′ of the two rods slides through a guide-hole made in the fixed cross-bar X′. On a lug formed on the bridge piece Y there is provided a central pivot *l*, on which is mounted a pair of pincers or tongs Z for holding the article or piece of metal *m* whilst under the action of the forging hammers R. These pincers or tongs may be grasped by one hand of the attendant whilst with the other he moves the sliding frame or rods W W′ longitudinally by means of a lever connected to the bridge piece Y by the central pivot *l*, and having its fulcrum attached to the end of one of the standards. By this means both the model and the piece to be shaped are caused to move together longitudinally, thereby bringing successively each portion of the entire length of the model in contact with the lever fulcrum or fulcra, whilst at the same time the piece to be shaped is passed longitudinally under or between the hammer or hammers. The action of the machine for carrying out the improved system of shaping articles by forging is as follows:—The metal to be shaped is held between a pair of tongs, and is either supported on an anvil (if one hammer be employed) or simply held between the tongs if one or more pairs of hammers are used. On starting the machine, the opposite hammers of each pair will strike simultaneously upon opposite sides of the article to be shaped, but each pair will act alternately where more than one pair are employed. As the operation proceeds the attendant slowly moves the sliding frame or rods W W′ longitudinally, by means of the lever before referred to, in order to bring each part of the length of the article under the action of the hammer faces, whilst at the same time the model is being moved in concert with the piece of metal along the guide-rod X, and operates upon the fulcra of the levers so as to bring the hammer faces nearer to the axial centre line of the piece of metal under treatment; or it allows the springs T T to move the hammer faces further from the article, and consequently causes such hammers to indent or compress the metal more or less at different parts according to the form of the pattern or model. The relative thicknesses of the manufactured article and of the model will obviously vary with the relative distances between the points of suspension or connection *e e* of the levers and the hammer faces and fulcra respectively. By placing the points of connection *e* midway between the hammer faces and the fulcra of the levers, the forged article will correspond in thickness with the model; but if placed nearer to the hammer face, then the thickness of the article will be proportionately less than that of the model, and *vice versâ*. It will be obvious to the practical man that the mechanical arrangements hereinbefore described may be varied, and that other methods of driving the hammers may be adopted without departing from the nature or essence of the invention; also that the motion of the piece of material operated upon and of the model may be rendered automatic.

## ORNAMENTAL BRICKS, TILES, SLABS, &c.

William Henry Ridgway *and* Frederick William Walker, *Hanley, Stafford—Patent dated December* 24, 1868.

This invention relates to a peculiar method of inlaying bricks, tiles, slabs, and other like articles composed of ground clay (commonly called dust). The patentees use, in addition to the ordinary plunger, a loose plunger, or plungers, built up of two or more parts, and placed on the surface of the dust in the mould, by which they are enabled to inlay and press up a tile or slab with the face upwards by the usual stroke of the fly-press.

The loose plungers are composed of two or more plates or sections perforated to any pattern, the inner plate fitting accurately into the outer one, and both being removed from the press every time a brick or tile is made. The loose plungers are made from $\frac{1}{8}$ to about $\frac{3}{8}$ of an inch thick, but their thickness will depend upon the depth of the inlaid portion and strength of plate required.

In a pattern of elaborate character the loose plungers are divided into several sections, each of which is manipulated separately, and then adjusted together with the others in order to be placed on the dust in the mould. The "sections" of the loose plungers are sometimes placed together within a square or other shaped ring or plate, plain or perforated, like the other parts, so as to hold the sections together.

In addition to the perforated inner and outer plates composing the loose plungers the patentees use, when required, a back plate to

Fig. 1.

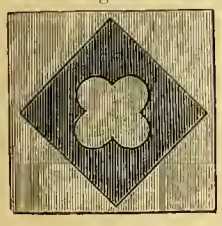
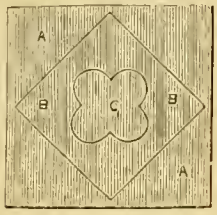


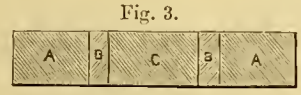
Fig. 2.




which the different parts of the inner plate are secured, in order that (when separated from each other by a bar, or some feature in the pattern) they may all move together under the action of the fixed plunger and fly-press.

They use also, when required, certain stopping-out plugs to fill up certain portions of the loose perforated plungers whilst other parts are being charged with "dust," which plugs are then removed, and the space occupied by them filled with "dust" of another colour. To charge the perforated portion of the loose plungers with "dust" they use boards with certain strips, stops, or pins fixed upon them upon which the loose plungers are placed. These strips or stops, according to their disposition on the board, allow the whole or certain portions only of the inner plates to drop a certain distance, leaving a vacancy to be filled up with "dust."

Fig. 3.

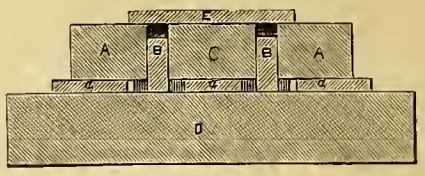



When more than one colour is required, the loose plunger partly charged with "dust" is moved to another board, where a different arrangement of stops allows another portion of the inner plate to sink, leaving fresh vacancies to be filled up with other colours; as each vacancy is filled up the "dust" is slightly compressed by a soft elastic pad previous to the whole being more fully condensed.

The mould having been charged with "dust" in the ordinary way, the loose plunger charged with the different colours is laid on the top of the "dust" in the mould, when a blow with the press drives it down into the mould inlaying and pressing up the tile.

The invention will be more clearly understood by aid of the annexed engravings. Supposing it is desired to produce an inlaid tile of the pattern and colours represented in fig. 1, the ground of the tile being, say, buff and the inlaid pattern blue, the patentees first construct the loose plunger composed of a metal plate A, fig. 2, of the exact size of the tile to be produced, and having a square opening made therein of the exact size and shape of the outer contour of the blue or inlaid portion of the tile, and correspondingly situate. A second plate B is then fitted accurately into the square opening in the first plate above referred to, and in the centre of this second plate an opening is made of the exact size and contour of the central buff portion of the design, into which opening there is fitted accurately a third plate C. Fig. 3 represents a vertical section through all these three concentric plates forming the loose

Fig. 4.




plunger, taken diagonally in fig. 2, the surfaces of the several plates or sections A, B and C being flush with each other. In this condition the loose plunger is placed upon a flat surface or table D, shown in vertical section at fig. 4 and in plan at fig. 5, the section being taken diagonally in fig. 6. Upon the surface of this table are provided a number of india-rubber or other stops *a a a*, which are so arranged as to support the portions A and C only of the loose plunger, leaving the part B free to descend to the surface of the table itself as shown clearly in fig. 4. This has the effect of leaving a recess in the surface of the loose plunger (see fig. 4) of the exact size and contour of the part B or, in other words, corresponding exactly with the inlaid or blue portion of the design. This recess is now filled with blue "dust" in any convenient manner, but it is found in practice that this may be more conveniently done by employing a shallow metal tray having a hole in the bottom corresponding in size and shape with the outer contour of the inlaid, or, as in this case, with the blue part of the design. The tray is laid upon the loose plunger with the square hole coinciding with the outer edges of the recess, and the blue dust contained in the tray is carefully swept into the recess beneath. The tray is then removed, and any superabundant "dust" is swept from off the surface of the loose plunger, leaving the parts A and C perfectly clean, whilst the recess remains filled with the blue "dust" up to the level of the surface of the loose plunger. A slab of india-rubber E, or a thin piece of leather (fig. 4) is then laid upon the loose plunger, so as to entirely cover and conceal the dust in the recess, and the pressing plate of an ordinary fly or other press is brought forcibly down upon the india-rubber slab E. This has the effect of depressing those parts A and C of the loose plunger which rest upon the elastic stops *a*, whilst the part B, which is supported on the solid bed or surface of the table itself, remains stationary; con-

Fig. 5.

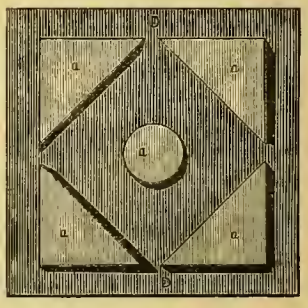
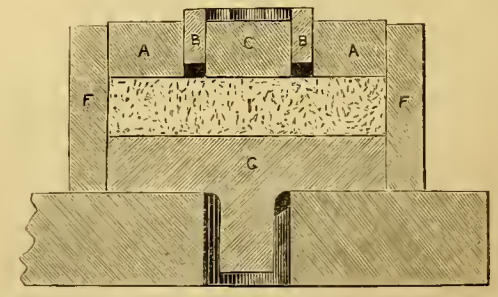


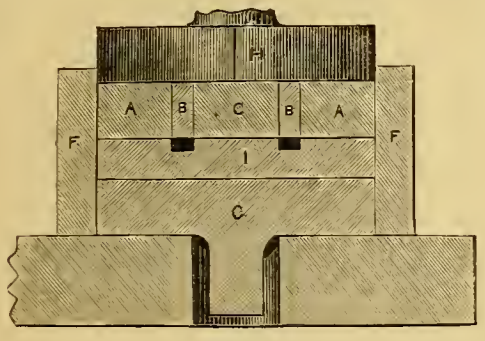

Fig. 6.




sequently the blue "dust" in the recess is compressed between the smooth surface of the part B and the under side of the india-rubber pad E, whereby it is sufficiently consolidated to remain in the recess when the loose plunger is inverted for the purpose of placing the same in the mould F shown in section at fig. 6.

Wooden or brass plugs may be employed for condensing or compressing the inlay "dust," but the india-rubber E will be found to be both cheaper and easier to work. This mould, which may be of the ordinary description, provided with a moveable bottom or piston G for expelling the completed tile, is filled with the buff "dust" forming the "ground" or body of the tile, and upon the surface of such "ground" is laid carefully the loose plunger already charged as described with the blue or inlay "dust," the several parts occupying the position shown in fig. 6. The top plunger or pressing-plate H, fig. 7, of a fly or other press is now brought down with powerful pressure on to the loose plunger, the effect being first to force down the protruding part B to a level with the parts A and C, the superior hardness of the previously compressed dust in the loose plunger admitting of its being thus punched, as it were, into the soft "ground" without spoiling the edges of the pattern, or becoming disturbed in any way, thereby imbedding or inlaying the blue "dust" into the surface of the body of the tile. The further descent of the pressing-plate H forces

Fig 7.




the entire loose plunger downwards inside the mould F, and solidifies the mass of "dust," thus completing the tile as shown in fig. 7. On raising the pressing-plate H the compressed tile, with the pattern in blue colour inlaid in its surface, is expelled from the mould F by elevating the moveable bottom or piston G. The operations are then repeated for the next tile, and so on.

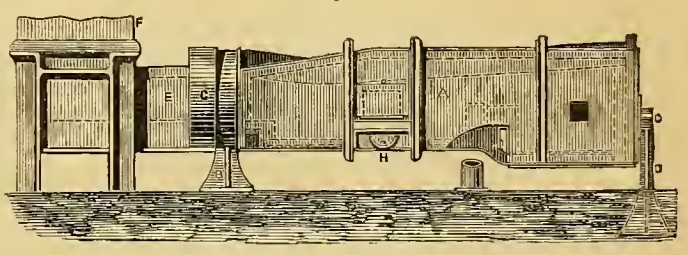
By employing loose plungers composed of various parts or sections fitting into one another, as hereinbefore described, facility is afforded for inlaying any number of different colours, since each recessed portion of the loose plunger may be filled separately with its own particular colour according to the design to be produced.

## MANUFACTURE OF IRON AND STEEL.

BERNHARD SAMUELSON, *Banbury.—Patent dated 31st Dec.*, 1868.

THIS invention has for its object—1st. To produce a superior quality of wrought-iron from pig or cast-iron containing phosphorus, silicon, sulphur, or other impurities. 2nd. To prevent sand, slag, and other extraneous substances from running into the moulds when iron or steel is melted in a reverberating furnace and run into moulds. According to the first part of the invention, the patentee proposes to purify pig or cast-iron in a reverberatory furnace, having, by preference, what is ordinarily known as a cinder bottom, and being, by preference, suspended for the convenience of discharging its contents. This purification may be effected by sueh appropriate re-agents as will dispense with the necessity of using a blast; and he carries on the purification until the iron approximates, as to its per-centage of silicon, to that contained in ordinary refined iron, during which operation a large proportion of the other impurities will also have been removed. The purified iron is then tapped out, and subsequently puddled in a puddling furnace. By this method it is easy to produce from cast-iron containing 1½ per cent. of phosphorus, wrought-iron in which the ultimate per-centage of phosphorus shall not exceed 1–10th to 2-10ths per cent. The metal, when purified or refined, is run into moulds, and the ingots or blocks are, whilst still hot, removed from the moulds and placed in a furnace by preference situated in close proximity to the puddling furnace, where they are removed in a heated state for the purpose of being puddled. The patentee states that, as he has found great economy to accrue from the employment of refined iron in a heated state when transferred to the puddling furnace, he proposes to apply this intermediate heating process to metal refined or purified either in accordance with this invention or otherwise. He prefers to run the purified metal into moulds, and to remove it from the moulds whilst still hot to a furnace in which it is kept hot until it is required for use by the puddlers. It is obvious that other refined metal, after it has been run into moulds, may be kept hot in a similar manner by a separate furnace until required for use by the puddlers. He has found that iron and steel, as it flows from the mouth of a reverberatory furnace, carries with it impurities which float on the surface of the molten metal, together with portions of the stopping from the tapping-hole. These impurities attach themselves to the sides of the moulds, and in some instances become encased in the metal when the latter is run direct into the moulds from the furnace mouth. Now, according to the second part of this invention, the patentee fixes or suspends in front of the furnace, and below the tapping-hole, a reservoir or ladle which receives the fluid metal but allows the scum to separate and float on the surface thereof within such reservoir or ladle. The bottom of this reservoir or ladle has an orifice which is closed by a moveable plug or valve, as in the ladle used in the Bessemer process. He further provides a carriage running on a tramway, upon which he places the moulds which are to be filled, and brings them successively under the orifice of the ladle. Fig. 1 of the accompanying engravings is a side elevation of a reverberatory furnace, constructed and arranged for carrying out the first part of the invention. The

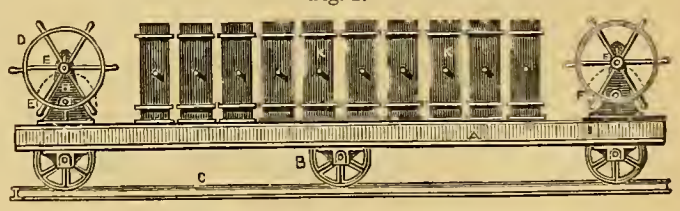
Fig. 1.




patentee prefers to suspend or pivot the main body A of this furnace upon a supporting bracket B and a trunnion C, the neck of the furnace resting in the concave surface of the bracket B, whilst the trunnion C rests in a bearing in the standard D. The throat E of the furnace leading to the chimney F remains a fixture, the junction between the moveable and fixed portions being effected by the ring G. The inclination or tipping of the furnace for the facility of discharging its contents through the tapping-hole H may be effected by various mechanical contrivances, but the patentee prefers to employ a cylinder, within which works a piston connected by links to a rigid arm or bracket secured to the side of the furnace, such piston being acted upon by hydraulic pressure.

Fig. 2 represents a carriage on which is mounted the ingot moulds to be filled; and fig. 3 is an end elevation of the same, showing also the reservoir or ladle, which is supported underneath the tapping-hole of the furnace. A is a long carriage composed of

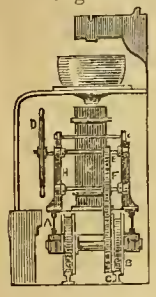
Fig. 2.




wrought-iron girders, or otherwise, and provided with the requisite number of running wheels B, which run along the rails or tramway C. This carriage may be moved or propelled along its rails by any suitable or well-known mechanical contrivance, but it is preferred to propel it by means of hand wheels D, situate at or near each

extremity; the axles of such wheels carrying spur pinions E, which gear into the spur wheels F, mounted on the shafts G, which rotate in bearings in the supporting frames or standards H. The wheels F gear into corresponding spur wheels fast on the axles of the running wheels; hence, on turning the hand wheels, the carriage with the moulds K K upon it may be caused to travel along its rails, and bring each mould in succession underneath the discharge opening in the bottom of the reservoir or ladle. This ladle is suspended or otherwise supported immediately under the tapping-hole, and is provided with a plug or stopper for closing or opening the discharge aperture made in the bottom of the said ladle or reservoir. By this mode of filling the moulds the slag, sand, and other similar matters are intercepted, and the ladle is not required to be removed from the furnace during the operation of casting.

Fig. 3.



## LAW REPORTS.

LOOMS.—CROSSLEY *v.* DIXON.—Rolls Court, before the Master of the Rolls, July 22, 1869. Sir R. Baggallay, Q.C., Mr. Grove, Q.C., Mr. Jessel, Q.C., Mr. Cracknall, and Mr. Aston appeared in the case.

The question in this suit was whether the defendants, who are carpet manufacturers at Kidderminster, are bound to pay John Crossley and Sons (Limited), of Halifax, the plaintiffs in the cause, a royalty for the user of certain looms during the year ending December 9, 1865, portions of the mechanism of these looms being, as the plaintiffs contended, protected by four patents, of which the plaintiffs are the assignees. The last of these patents expired on December 9, 1865.

His Lordship, in delivering judgment, said that the result of a perusal of the evidence, and a personal inspection of the defendants' loom, was that the defendants had not, in his opinion, used any of the inventions protected by the plaintiffs' patents, and consequently that no royalty was payable. He thanked Mr. Collier and Mr. Bramwell, the two gentlemen who had attended him on behalf of the respective litigants during his inspection of the looms. Nothing could be clearer or more lucid than the explanations they gave of the several processes. The result of the conclusion he had come to was that the bill must be dismissed with costs, except that the defendants must pay the costs of so much of the suit as was occasioned by the contention on their part that the question was concluded by the former suit between the same parties.

HORSLEY AND KNIGHTON'S PATENT.—Court of Appeal, before Lord Justice Giffard, July 25, 1869. This was an appeal from an order made by the Master of the Rolls on the 15th inst., to expunge an entry in the register of patents.

Sir R. Baggallay, Q.C., and Mr. Cracknall were for the appellant.

Mr. Jessel, Q.C., Mr. E. Rodwell, and Mr. T. Aston (of the common law bar) took the objection that there was no right of appeal in this case, inasmuch as the jurisdiction of the Master of the Rolls to expunge the entry was a purely statutory jurisdiction given by the Patent Law Amendment Act, 15 and 16 Victoria, cap. 83, which Act gave no right of appeal. The 38th section of that Act is as follows:—

"If any person shall deem himself aggrieved by any entry made under colour of this Act in the said register of proprietors, it shall be lawful for such person to apply by motion to the Master of the Rolls, or to any of the Courts of common law at Westminster, in Term time, or by summons to a Judge of any of the said Courts in vacation, for an order that such entry be expunged, vacated, or varied; and upon any such application the Master of the Rolls or such Court or Judge respectively may make such order for expunging, vacating, or varying such entry, and as to the costs of such application, as to the said Master of the Rolls or to such Court or Judge may seem fit; and the officer having the care and custody of such register, on the production to him of any such order for expunging, vacating, or varying any such entry, shall expunge, vacate, or vary the same according to the requisitions of such order."

Lord Justice Giffard was afraid that the matter was too clear for argument. It was much to be regretted, as it was as reasonable that there should be a right of appeal in a case of this kind as in any other case, and probably a right of appeal would have been given by the Act if the attention of the Legislature had been called to the matter. But the Act created an entirely new register of the proprietors of patents, and then came section 38, which gave the jurisdiction to make an order for expunging an entry on the register to the Master of the Rolls, but not a word was said about an appeal from his decision. If no right to appeal was given by the Act, this Court had no power to interfere. The application must, therefore, be refused with costs.

ELECTRIC BELTS.—PULVERMACHER *v.* HAMMOND AND ANOTHER.—Court of Chancery, before Vice-Chancellor Sir. R. Malins, July 27, 1869.

Mr. T. A. Roberts appeared for the plaintiff, and Mr. Graham Hastings for the defendants.

This bill, filed some time ago for an injunction to restrain the defendants from advertising in a manner which might in any way interfere with the plaintiff's business, now came on to be heard as a short cause, the principal defendant (Barrow) having consented to a decree (not to contain the words "curative belts") for a perpetual injunction. The plaintiff not pressing for them, no order was made as to costs.

EJECTOR CONDENSERS.—BARCLAY'S PETITION FOR PATENT.—Before the Solicitor-General, August 13, 1869.

This was a Petition of Mr. Andrew Barclay, of Kilmarnock, N.B., for Letters Patent for "Improvements in Ejector Condensers, and in exhausting liquids and fluids from Condensers and other chambers," dated 2nd February, and numbered 312, 1869. The opposition was entered by Mr. Alexander Morton, of Glasgow; and his notice of objections stated the objections to be, that he had reason to believe that Mr. Barclay had included in his application the whole or material parts of his (Morton's) invention.

The declarations filed on both sides were exceedingly voluminous, and upwards of twelve large drawings were exhibited. It appeared from the declarations that Mr. Morton, being in the service of Mr. Barclay, as draughtsman, in the year 1863, Messrs. Barclay and Morton took out a joint patent, No. 2775, 1863, for raising and forcing fluids generally, and injecting or ejecting fluids or gases by a steam jet directed between two flat or curved annular surfaces or discs, the steam acting as a continuous piston between such surfaces, and creating a vacuum which lifts the fluid. Mention is first made in this specification of the admission of the exhaust steam from a steam-engine cylinder into the apparatus, in which case the condensing chamber of the apparatus would act as the condenser does in other engines. This indicated the application of the apparatus for condensing the exhaust steam of steam engines, and the ejecting or blowing out of the condensing water and the condensed steam.

This was followed by a patent taken out by Mr. Barclay alone, No. 1151, 1864, in the specification of which is shown a compound apparatus, two barrels containing a central jet of steam, an annular jet of water surrounding the same, and another annular jet of steam surrounding the annular jet of water. The condensing surface is thus considerably increased, as the interior and exterior surfaces of the annular jet of water are made available, and the two combining surfaces are made available by the vice versâ arrangement when desired, as specified; that is to say, by using a jet of steam between two jets of water. Mr. Barclay caused an elaborate series of experiments to be made with apparatus of this description until the year 1867; such experiments, as he alleged, being conducted with Morton's knowledge and assistance in the usual course of his duties. Mr. Morton, however, left Mr. Barclay's employ in the year 1867, and immediately afterwards took out a patent, No. 2106, 1867, in which he showed an apparatus wherein a jet of water was maintained by the action of exhaust steam from the low-pressure engines, introduced through the branches A and B alternately; such jet of water being annular, and situate between two steam jets, the jet of water serving at the same time for the condensation of the steam which impels it. A central steam jet pipe was used, on first starting the engine, for producing the jet of water. This steam jet pipe is concentric with the water nozzle. Outside this water nozzle was another steam nozzle, thus combining a central steam jet, an annular water jet, and another annular steam jet outside that again; or the annular water jet may be steam and the annular steam jet water, by a vice versâ arrangement, as set forth in Morton's specification.

Mr. Barclay again, in the year 1868, obtained another patent, No. 1216, for further improvements. The specification shows and describes a modification of Mr. Barclay's apparatus of 1864, applied as an ejector condenser for condensing the exhaust steam of engines, and ejecting the condensed steam and condensing water. Here the annular water jet intervening between two steam jets of the former apparatus is preserved, in addition to which a foot valve is applied to the discharge pipe; a vacuum chamber is also added between the combined steam and water nozzle and the discharge pipe or throat, and an equalising chamber is interposed between the steam-engine cylinders and the branches leading into the apparatus, for the purpose of equalising the flow of steam through such apparatus.

Mr. Morton obtained a further patent in 1869, No. 456, which, although dated after Mr. Barclay's patent of the same year, was sealed and specified before Mr. Barclay's patent was sealed. It is not necessary to describe the improvements contained in this specification, as at the hearing nothing material turned upon it.

Declarations of Mr. Barclay himself; Mr. J. P. Smith, Secretary of the Society of Engineers in Scotland; Mr. Greig, the general manager of the Coltness Ironworks; Mr. Barclay's general manager, foremen, draughtsmen, and pattern maker; Mr. St. John V. Day, C.E., Patent Agent, Glasgow; and Mr. E. P. Alexander, C.E., Principal Mechanical Assistant to Mr. J. Henry Johnson, of 47 Lincoln's Inn Fields, were filed on behalf of Mr. Barclay; whilst Mr. Morton's case was supported by declarations of Mr. Morton, Mr. Gale, and others (the President and Officers of the Institution of Engineers in Scotland), and by Professor Rankine.

The declarations contained the usual amount of confliction in matters of fact, as well as of opinion, amongst other matters, Mr. Morton alleging that the term "ejector condenser" was first suggested to him by Professor Rankine in November 1868, whilst Mr. Barclay stated the term was first suggested by his brother, James Barclay, in the year 1862, and that the apparatus was commonly so called in his works from that time to the present.

Mr. Webster, Q.C., instructed by Mr. J. H. Johnson, of 47 Lincoln's Inn Fields, and Messrs. J. H. Johnson and Day, of Glasgow, appeared for Mr. Barclay. Mr. Aston appeared for Mr. Morton.

The Solicitor-General, after hearing both parties for about two hours, came to the conclusion that Mr. Barclay's Provisional Specification contained matter which was not shown in Mr. Morton's specifications, and that Mr. Barclay was therefore entitled to have his patent sealed, and that there was nothing in the case which entitled Mr. Morton to call upon him to restrict Mr. Barclay's application in any way.—We understand that this is a mere prelude to further litigation between the parties; Mr. Barclay alleging that Mr. Morton has erected apparatus which infringes Mr. Barclay's patents, whilst Mr. Morton, on the other hand, alleges that apparatus erected by Mr. Barclay infringes Mr. Morton's patents.

## REVIEWS OF NEW BOOKS.

*Diseases and Injuries of the Eye; their Medical and Surgical Treatment.* By George Lawson, F.R.C.S., Surgeon to the Royal London Ophthalmic Hospital, Moorfields, and Assistant-Surgeon to the Middlesex Hospital. Renshaw, London, 1869, pp. 339.

This is a treatise by the author of "Injuries of the Eye-Orbit and Eyelids, their Immediate and Remote Effects," previously noticed in our pages; and although, strictly speaking, the subject is beyond our sphere, we may remark that an examination of the work convinces us that it is a comprehensive, compact, and well-arranged treatise on one of the most special branches of surgery. The author is well known as a successful practitioner in his treatment of the eye when suffering from injury or disease; and his extensive experience, combined with his enthusiastic study of the affections of this complex organ, has enabled him to produce a useful manual, which we have no doubt will be much consulted by his fellow-labourers in this field. It comprises an account of all the medical and surgical affections of the eye, with the treatment essential for their relief; and its eleven chapters treat of the diseases of the conjunctiva, diseases of the cornea and sclerotic, diseases of the iris and vitreous humour, diseases of the crystalline lens, diseases of the retina, choroid and optic nerve, anomalies of refraction and diseases of accommodation, strabismus, special injuries of the eye, diseases of the lachrymal apparatus, diseases of the eyelids and diseases of the orbits. These are followed by a formulary of prescriptions and a page of test-types for astygonatism. Thirty-eight woodcuts illustrate the text.

*Charts showing the Surface Temperature of the South Atlantic Ocean in each Month in the Year.* Compiled from Board of Trade Registers &c. Issued by the Committee of the Meteorological Office. Folio, 1869. Stanford.

This large thin volume of Atlantic charts constitutes one of the most important additions that has been made for some time, not alone to meteorology, but to an important branch of cosmical physics, namely, the advancing towards something like a complete knowledge of the facts of the oceanic currents at all seasons of the year. We know for long a very few great phenomena of this sort, such as the Gulf-Stream, that along the west coast of South America &c.; but of the ocean currents, as a whole, as parts of a vast and complicated hydrostatic machinery, tending to equilibrate temperature, we know next to nothing; as to the minor currents, not littoral, we may say nothing at all. Here we have one great addition to our scanty information, on pretty sure and minute data; and it does great credit to the meteorological committee, acting with authority of the Board of Trade, and to Mr. Robert H. Scott and the other gentlemen who have carried the work out.

## FOREIGN LITERATURE.

*Traité pratique du chauffage, de la ventilation et de la distribution des eaux dans les habitations particulières, à l'usage des architectes, des entrepreneurs et des propriétaires.* Par V. Ch. Foly. 8vo. illustrated. Baudry, Paris, 1869.

This is at once the best practical book on those important subjects, relative to house construction, viz. the supply of warmth, that of water, and that of fresh air, that we have met with; it is also a very elegant and student-like book.

It reflects the mind and information of a man who apparently has had a good deal of practical experience in the matters of which he treats, with the archæological lore and cultivated tastes of the trained architect. After a brief and sparkling introduction, full of good sense—in which, let us remark in passing, the author makes a rather amusing mistake as to the real meaning of our English phrase "well-aired beds" seen over our coffee-shops &c., which he translates *Lits bien aérés*, in place of *Lits secs* or *bien séchés*, and then goes on to comment upon his view of the lodging-house bed, as a proof of our English notions of the value of good ventilation—the author goes on to a still more brief *résumé* of the elementary principles of the physics of heat, quite enough in six pages for his purpose, and then to his second and third chapters, on air and on water generally.

We then have the subject of baths, traced historically, and the varieties of existing practice in the chief civilised nations, as regards baths in private houses, very well described. Some of the contrivances for domestic baths and heating the water employed in very recent practice in France were new to us.

The next chapter goes to cisterns, filters, ice repositories, washing apparatus, and so forth.

Then we traverse the whole subject of heating rooms or houses, historically traced, and as before the most recent practice given. Some of the author's remarks here, upon the construction of grates and fireplaces, are very judicious and useful. In chapter 7 we have the history of methods of ventilation traced; the relations of the subject to public buildings, hospitals, churches, theatres, public concert halls, schools &c., which have been so exhaustively treated of by General Morin in his *Études sur la Ventilation*, are glanced at; and then we have pretty fully all that has most recently been effected in improving the means of ventilation for our private rooms.

As to the extent or value of these improvements, we cannot say very much. It is much easier to ventilate effectually and comfortably a theatre, or church, or prison, or hospital, to hold five or ten thousand people, than a private sitting-room of 15 or 18 feet square; and, in fact, the problem of a sufficient supply of fresh air, free from chills or draughts, in our living or bed-rooms, remains still to be solved, and, with existing social and house-building conditions, is not likely soon to be solved.

The book, which is not a large one, ends with a general *résumé* of the principles of ventilation, and with a useful bibliographical table of all the authors, papers, reports, &c. &c., treating of the different heads of the entire subject.

*Les Éclairages modernes.* Conférence de M. l'abbé Moigno, 1867. Small 8vo. Paris, Gauthier-Villars.

This is the publication of a lecture given by the Abbé Moigno, in Paris, in which a popular, but professedly exact, account has been given of recent improvements in the methods of lighting for all purposes.

Illumination by lamps, burning oils and purified petroleum; the magnesium light; that by the mixed gases—oxygen and hydrogen—upon lime &c.; the several forms of electric light &c. are all described and, in numerous cases, illustrated by woodcuts. The little work has the characteristic *netteté* of the French "*savant vulgarisateur*," but it suggests some suspicion of being, perhaps, a thought biassed here and there. How is it, for example, that in describing the various methods of producing oxygen gas—upon manufacturing conditions as to price and quantity &c.—not a word is said of M. Mallet's beautiful process, which has been so fully described and approved elsewhere in France, and was shown in operation in the Champ de Mars in 1867?

The work is just now perhaps, also, a little behind time; nothing, for example, is said about the substitution of *Zirconia* for lime, partially or wholly, in the oxy-hydrogen light, which has made so great a noise recently at Paris, and is said, with more or less reliability, to be a vast advance in improving the Drummond light and rendering it practicable and constant. Next to heat air and water, light is our most important want in relation to the habitation. It deserves a better popular book than this, and, no doubt, in an improved edition the author could produce such.

*Bilder-Atlas; ikonographische Encyclopädie der Wissenschaften und Künste. Ein Ergänzungswerk zu jedem Conversations-Lexicon.* Brockhaus, Leipzig, 1869.

The first five parts of this strange publication have reached us. It consists of extremely well-executed copperplates of all sorts of subjects and things found in the great German encyclopædia, the *Conversations-Lexicon*, issued at the low price of 7½ silver groschen for each part, in small folio of five or six fine plates, but without text. It is only in Germany that such a work can be produced at

such a price, but who are to be the buyers of it we are scarcely able to imagine, in its present state at least. The plates of human osteology amongst these first parts are perfect gems of engraving, as are also those of natural history.

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*Die Haupttheile der Locomotiv-Dampfmaschinen &c.* Bearbt. v. C. Schepp, Civilingenieur, Heidelberg, 1869. 1 vol. 8vo.

Mr. Schepp is a clever fellow in his line. So much we can say, though having only seen the text of his work with its four plates, but not the folio atlas of 16 constructive plates promised along with it.

In the first part the author clears the table, so to say, by a didactic and critical survey of all the different classes and constructions of locomotives which have got into established use. In the second part he proceeds to construction rules, and deduces *ab origine* the proportions &c. of all the important parts, including some of the most recent German modifications and improvements of valve gear. It is a very useful book, to the reader of German, for the purpose proposed by the author, "self-study;" the best education that mechanic or any other adult man can ever receive—that which he gives himself; the only one that leaves no fortresses of ignorance in the rear, as all pupil-teaching often does, and as "cram" is sure to do.

Since the foregoing was written, Herr Schepp's atlas of plates has reached us. They are excellent and clear engravings, and valuable to the practical locomotive builder, all the necessary dimensions being given in figures, and a special system of cross-lining now commonly accepted in Germany is adopted by which the constructive material of every part is obvious to the eye without the aid of colouring.

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*Nouveaux problèmes de Physique, suivis des questions proposées au concours général depuis* 1805 *jusqu'à* 1867 *dans les classes de physique et de chimie.* Par M. E. Bary, Prof. au Lycée Charlemagne, Répétiteur à l'École Polytechnique. 2e édit. par L. Brion. 8vo. Hachette, 1867.

These problems, which embrace the entire scope of physical and chemical knowledge, are not those alone proposed by the late M. Bary (as might possibly be supposed), extending, as they do, over the long period of 62 years, but are those given to the candidates for degrees &c. during this long period, and by almost all the great celebrities of science of France during the epoch. Many are demonstrated or developed: the appendix contains questions only. The volume is quite a mine for the science examiner from which to dig questions; and to any student of science is a first-rate volume whereby to test the reality and exactness of his own knowledge. To those really interested in our own system of national scientific middle-class education, the volume affords a good example of the general standard of question, and therefore of knowledge, exacted from the French student, as compared with the British one: the advantage is all on the side of France.

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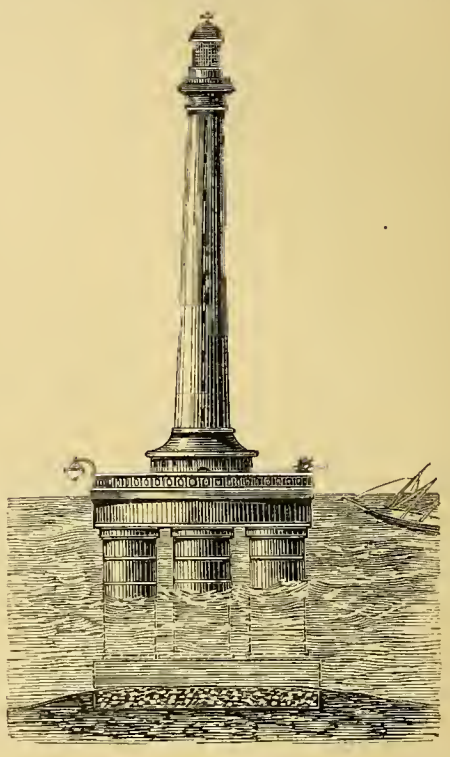
## CORRESPONDENCE.

☞ We do not hold ourselves responsible for the views or statements of Correspondents

### LIGHTHOUSES.

TO THE EDITOR OF "THE PRACTICAL MECHANIC'S JOURNAL."

Sir,—In the absence of rocks, there are many places of as dangerous a character for the mariner to avoid in his voyages across the trackless deep. There can be no doubt that, when we can secure a good foundation, a stone edifice, reared on a sunken rock, is a very safe building; a pillar of imperishable granite, that will resist the impact of storm waves from generation to generation. However, there are many places where we cannot get a base to work upon, and it is to such that I would direct your attention with the view to devising a method of laying down foundations to rear a structure upon. We are all agreed that lighthouses should have a bold appearance by day, and, if possible, an "electric light" by night; and that it is absolutely necessary that the light be placed at a great elevation. We likewise understand that the waves become powerful only when resisted, and that a lighthouse depending on its weight, and not on its strength of fixtures, which are very liable to deteriorate, is the best method of resisting the enormous force of the waves. Such a structure must present the least surface or point of attack, and if we can divide the wave we thereby lessen its force. Granite buildings, however, are not suited for many foreign waters, owing to the enormous expense of working the huge blocks, and I have endeavoured to meet these difficulties with a metallic and concrete structure, depending on its own weight to resist the most tempestuous weather. It is a bad plan to build on the sand, but where we cannot obtain a better foundation than that offered by a sandy or gravel bottom, we must simply lay down a base of sufficient area, so that the great weight necessary may be distributed over a large surface; of course the nature of the soil will determine the size of the basement. In this instance we will presume that a square of 80 feet on the side would be sufficient, with a depth of 16 feet. The main column, or central pillar, would be continuous, built up from the bottom of basement, or bed of the sea, to the requisite height, while there would be six cylinders ranged around, carried up from the bottom of basement to the top of the platform: they would be all secured one to another at the bottom, and the basement built round about them with suitable metallic plates, securely jointed together, and made perfectly



water-tight, the space between the columns being filled up with concrete. The structure could be erected in shoal water, say to the height of the platform, and, with suitable pontoons, buoyed up and towed to its destination. As the columns would be perfectly water-tight, they would displace a large body of water, so that the pontoons need not be very large; indeed pontoons may be dispensed with, by not carrying the structure up so high in the first instance. After arriving at its destination it would be sunk by simply admitting water inside the columns, and then, one by one, the water would be pumped out, and concrete precipitated from above, filling all the columns, as likewise the capital or platform; thus a foundation of great weight, strength, and stability could be laid down in moderate depths. It would then merely be a work of time erecting the main column, with all the necessary staircases &c. Of course, in the case of such a lighthouse, suited for moderate depths, the waves would not rise to a great height, so the distance in height from the level of the sea to the underside of the platform need be no higher than shown in the annexed engraving; the wave should be broken up before reaching that height, and the columns would effect this. I consider the stability of such a form would be very great, considering the mass of material centred at a few feet above the basement. Metallic and concrete structures are still in their infancy; and I trust my advocacy of this mode of constructing lighthouses (in which everything depends upon weight alone, all the fastenings being inside of the structure and thoroughly protected from the sea-water with a solid lining of concrete,) may prove of some service in protecting and guiding the lonely mariner in his perilous vocation.

I am, yours truly,

13 Gladstone Street, St. George's Road: John G. Winton.
6th August 1869.

P.S.—The estimated weight of cast-iron in such a structure would be nearly 2,500 tons, while there would be about 8,500 cubic yards of concrete in the foundation; and I consider such a lighthouse, having massive foundations, with the light placed 184 feet above the level of the sea, could be constructed much more cheaply than lighthouses built of stone, and for certain situations would prove infinitely better than those constructed on screw piles; and as the foundations could be erected in smooth water, then floated and sunk on the bed, I consider the plan much preferable to the modes usually adopted. The ample promenade provided would prove much more healthful for the lighthouse keepers than being cooped up in a confined tower; and I trust such a mode of constructing lighthouses will be able to resist the seething billows—as likewise the breakers of prejudice. I will merely add that such a lighthouse as I have described, constructed on a rock washed by the waves, would prove much more stable than a single column of cast-iron depending greatly on the strength of holding-down bolts.

# PROCEEDINGS OF SCIENTIFIC SOCIETIES.

## INSTITUTION OF MECHANICAL ENGINEERS.

The Annual Congress of the Institution of Mechanical Engineers opened on Tuesday the 3rd ult., in the Theatre of the Literary and Philosophical Society, Newcastle, under the presidency of Sir Wm. G. Armstrong, C.B. A programme of a very excellent character was placed in the hands of the members. The papers furnished, though not numerous, dealt with several important questions, especially as bearing upon the ventilation of collieries, revolving furnaces for chemical works, the firing of steam boilers, and other matters of considerable value. A very comprehensive and agreeable series of excursions were also arranged, and the members spent a very pleasant week in inspecting most of the important industrial and other establishments in the two northern counties. The attendance at the opening meeting was very numerous.

Sir William Armstrong, in opening the proceedings of the meeting, explained that it would have been more proper that the opening address should have been then read, but it had been thought more expedient to reserve it for the evening meeting, as many members who were not likely to arrive till the mid-day train would be then present.

A paper, prepared by the President, being a description of "the hydraulic swing bridge for the North-Eastern Railway over the River Ouse," near Goole (on the new Hull and Doncaster line), was then read by the Secretary.

The Secretary next read a paper on "the Mechanical Ventilation of Collieries," by Mr. William Cochrane, of Elswick, from which we make the following extracts:—

"It must be admitted that in the great advance which has been made in the development of mining enterprise, and looking to the future requirements of our local coal fields, adequate ventilation is not inferior in importance to any of the problems which the mining engineer has to solve. The earliest records of mining make us acquainted with the readiest mode of ventilation, no provision beyond the natural conditions being adopted; and so long as mines were only worked to a very limited extent by levels or 'adits,' and if by shafts, of very small depth, the natural system was found to answer all requirements; only there was this disadvantage—that, with thermometrical variations, the determination of the current of air was dependant on the average temperature of the mine being above or below that of the external atmosphere, a condition constantly varying and interchanging throughout the year, and, therefore, not permitting any certainty of action in the direction or quantity of air which could be used for ventilating the mines. This system is still used in mines of limited extent, and where, from the nature of the mine, very small resistances are offered to the current of air circulating. In some cases, under these conditions, as in the Staffordshire 'thick coal' mines, the determination of the air into a particular course is often ensured by placing a fire lamp in the upcast shaft. Such a contrivance, however, can only produce a very small effect, and is, therefore, of limited application. On a larger scale, however, this principle has formed the most generally adopted system of mine ventilation in this country, namely, that of the furnace." The paper then described the system now most generally in use, and went on—"Much discussion had arisen as to the best system of furnaces and the most economical mode of feeding them with air. The following were the results of some recent experiments that had been made at different collieries in the northern coal fields under various conditions and depths of shafts, extent of workings, and thickness of the seams of coal, and were reduced for the purpose of comparison to the duty that one pound of coal consumed effected per horse power on the air circulated in the mine; the pressure being indicated by a water gauge placed in the mine, and therefore representing only the work done in overcoming the friction down to the mine, and exclusive of the work required to overcome the friction resistance of the two shafts. The general result of the experiments was that that duty varied from 37 lbs. to 101 lbs. of coal per horse power on the air taken upon currents of air ranging from 40,000 to 120,000 cubic feet per minute. Depth of shaft, it said, is the most important consideration for the efficient application of a furnace. There are other conditions, however, which it is necessary to secure, namely, that the shaft be dry, and that it be lined with a good heat-retaining material. It is considered a fair estimate of the economic value of the average conditions in which furnaces are worked that only five degrees of the heat due to the combustion of the coal are utilised. There are many objections, besides the small useful effects in the use of the furnace, which cannot be overcome, and which form a constant source of cost attendant upon it, namely the necessity of cleaning the flues and the consequent suspension of the active ventilation of the mine; the inconvenience, and in some cases the impossibility, of using a shaft highly heated, and often full of smoke, for any other purpose than as a ventilating shaft; and the serious damage done to cast-iron tubing, timber, pumps, or wire ropes where winding is carried on in the up-cast shaft by the products of combustion, especially where the shaft is damp. If the conditions are unfavourable for the use of a furnace, such as shallow shafts and heavy resistances to be overcome, the furnace is then quite unable to compete with a good mechanical ventilation for economical effect. The limit of the furnace as a ventilating power is soon reached where the resistances offered by a mine are heavy, and this objection materially led to the adoption of other means to meet the conditions under which the furnace would fail to afford a sufficient ventilation. Machines for blowing fresh air into or exhausting the foul air from mines were adopted in the very earliest times, especially abroad, where the conditions of the seams are such as required more efficient means than the furnaces supplied. Hence it is that mechanical ventilators are very numerous abroad, while in this country until very recently they were quite exceptional. In a table compiled by Mr. J. J. Atkinson, Government Inspector for the Durham Coal-field, has been shown the depth at which furnaces are estimated to be equal to ventilating machines in point of economy of fuel, assuming that the sources of loss are of the same extent in each case, that is the loss of fuel in furnacea by cooling in the upcast, and in ventilating machines the power expended in overcoming the useless resistances, and that the ventilating machines utilised 60 per cent. of the engine power. The general result is that the minimum depth at which the economy by the two plans is equal is 960 yards, with an average upcast temperature of 100 deg. Fahr., and a depth of 1,130 yards with 200 deg. Fahr. temperature, estimating a consumption of 8 lbs. of coal per hour per indicated horse-power of the engine. A recent calculation by M. Gnibal of Mons deduces the following comparisons: that if a furnace in a 12-feet shaft, 400 yards deep, circulate 53,000 cubic feet of air per minute under the total resistances represented by 3½ inches water gauge, and an average excess of upcast temperature of 108 degs. above the downcast, with a duty of 31 lbs. of coal per horse-power in the air estimated upon the total resistances, a mechanical ventilator utilising 60 per cent. of the power employed would, under the same conditions, have a duty of 11 lbs. of coal per horse-power in the air, being a saving of 64 per cent. At a depth of 550 yards to circulate the same volume, the duty of the furnace being 22 lbs. of coal, that of the mechanical ventilator would be 11 lbs., being a saving of 50 per cent. The paper then classified the mechanical ventilators which had been used under two heads—first, those working by centrifugal action; and, second, those working as pumps. Of those of the first class, one had been described at the last meeting—the Guibal ventilator, at Cradley Colliery, Staffordshire. The largest example, it went on, of that class erected in this country will be seen at the Thrislington Colliery. It is 36 feet diameter and 12 feet in breadth, driven by a horizontal cylinder 30 inches diameter and 30 inches stroke. This ventilator has only been recently erected, and is not yet ventilating any large extent of working, but some experiments have been made with it, from which the following results have been obtained. The regulating shutter was not properly adjusted so as to give the best results of working, and the drift to the upcast shaft was too small for accurately increasing the current of air, amounting to 80,000 cubic feet per minute. With 54 revolutions per minute a water gauge of 2½ inches was maintained at the inlet; with 70 revolutions a water gauge of 4½ inches, and with 80 revolutions a water gauge of 6¼ inches." After giving the results of other Guibal ventilators in operation, the paper continued—"In order to make a fair comparison of the Guibal ventilator with the furnace, the following case of the Pelton Colliery, Durham, is given, as it is the only one where the data have been accurately ascertainable respecting the replacing of the furnace by this mechanical invention. In this case the duty obtained by the furnace was 102 lbs. of coal per hour per horse-power in the air estimated, on the water gauge of 1 1-10th inch indicated in the mine, and a current of air of 35,000 cubic feet per minute; and the duty was reduced by the ventilator to 20 lbs. per hour per horse-power with a current of 54,000 cubic feet, and a water gauge of two inches indicated in the same position. This shows a saving of fuel by the adoption of the Guibal ventilator in place of the furnace, amounting to 80 per cent. The class of ventilators to which the Guibal belongs is that of centrifugal action, and in the same class may be mentioned the Biram, Nasmyth, Brunton, Rammel, and Waddell ventilators. [Diagrams of the Nasmyth, Rammell, and Waddell ventilators were exhibited.] A Biram ventilator (similar in principle to the Nasmyth, with the exception of the vanes being inclined to the radius,) the writer has experimented upon at Tursdale Colliery, Durham, and found that only 12½ per cent. was utilised of the gross power supplied from the steam boilers; and from experience with other open running fans, he considers that percentage cannot be materially exceeded with any form of open fan without a casing. A Waddell ventilator recently erected at Pelton Colliery utilises only 39 per cent. of the power applied; and a Rammell, at Framwellgate Moor Colliery, does not exceed 40 per cent. of utilised power. The Guibal utilises 60 per cent. of the power applied. Except the Guibal, all the other ventilators of this type discharge throughout the entire circumference; but that this is a defect can be inferred from the fact that if such a fan open running have the access of air into its centre stopped, great power will still be required to make it revolve, though no useful work is done. The useless work done upon the external air in this case is done to a diminution of useful effect, when the fan is exhausting air supplied at its centre from any mine drift or passage. It was anticipated that the Waddell ventilator would obviate this defect by arranging the air passages through fans of a gradually decreasing section from the centre to the circumference, so that the velocity of rotation at any point multiplied by the sectional area of passage at that point should be constant, thus filling up the fan with issuing air, and preventing the possibility of re-entries. In this case, the re-entries cannot be seen as in the Biram, where the eddies of air all round the circumference are easily distinguished, but that they do evidently arise is proved by the low power utilised. The Brunton, which closely resembles the Waddell and the Rammell, cannot be expected to yield any better results. By the kind permission of Mr. Daglish, the results of a Rammell ventilator, recently erected at the Framwellgate Colliery, are here given:—Diameter of ventilator, 22 feet, with 20-inch steam cylinder, and 102 revolutions per minute; volume of air, 53,600 cubic feet per minute, with a water gauge of 2⅛ inches; result, 40 per cent. utilised. One of the chief reasons of the low useful effect of these exhausting fans is that they are exposed throughout the entire circumference to the external air, which rushes in behind the vanes to supply the vacuum formed by their revolutions; but this vacuum ought to be supplied only from the mine to be ventilated; and it was this consideration, and the practical proof that this injurious effect was inherent in open running fans, that led to the casing of the Guibal ventilators and discharging the air at only one part of the circumference. This step, however, was attended with the objection that the air was discharged with a high velocity, viz. the velocity of the periphery of the fan, and carried away with it a most important store of force, the partial utilisation of which has been effected by adapting the principle of *evased* tubes to the expanding chimney, in which the casing of this ventilator terminates. The air, entering its base at a high velocity, leaves the chimney at a reduced velocity proportionate to the increased area of the outlet, and in this action restores a considerable amount of power it would otherwise carry off. An adjustable shutter was next found necessary in order to regulate the size of the outlet and the various conditions of the volume of air required and resistances. A series of very interesting experiments had been made showing the steadily-improved results obtained from the ventilator, as the casing chimney and shutter, in its

accurate adjustment, were consecutively added. Generally, as to the powers supplied from the steam boilers for working these ventilators, 60 per cent. was found to be utilised; but it must be noted that this amounted to at least 80 per cent. of the power actually transmitted to the ventilator, as one-fourth of the boiler power must be allowed for the loss due to the friction and imperfection of the steam-engine. One of the ventilators (of which several examples were now in use in this country of 36-feet diameter) had been recently started in Belgium of 40-feet diameter, but detailed experiments had not yet been made upon it. It was arranged to work at the speed of eighty revolutions per minute, producing a ventilation of 150,000 to 200,000 cubic feet of air per minute, under a depression of water gauge of about seven inches, which was certainly the maximum requirement of any known condition of mines. Indeed there could be no question that any practical requirement in the ventilation of mines could be satisfied by this system, and it could not be surpassed in simplicity of construction, small liability to accident, and the little wear and tear to which its working parts were subject." The paper next pointed out peculiarities in the Guibal ventilator—as to the concentric form of the casing and as to the curving of the vanes; and it then dealt with the second class of mechanical ventilators, that in which the principle of variable capacities, as in the pump, was involved. Struve's air-pump ventilator was the best known of the class, and consisted of two gasometer-formed pistons working in rings of water, alternate upward and downward strokes drawing air from the mine and forcing it into the atmosphere by means of suitably arranged valves. The Struve was, when well constructed and in good order, capable of producing a very satisfactory exhaustion, but for certain reasons it did not offer the advantages for mine ventilation which the centrifugal action fan did. The useful effect was from 40 to 45 per cent. of the boiler power, when all the working parts, and especially the air-valves, were in good condition. In conclusion (to quote the words of the paper), the economy of fuel, if neglected hitherto, has now become of paramount importance. To increase the amount of air in any given time, the mine requires the consumption of an increased quantity of fuel, proportionate to the cubes of the volumes; thus, for twice the volume eight times the fuel. Hence the best system of ventilation is that which, under the same conditions of mine and the same amount of first outlay, produces the maximum work for one pound of coal consumed, so long as such ventilation compares satisfactorily with any other in the points of durability and cost of working, and possesses the quality of adaptability to all the varying conditions which are met with in mining operations.

A paper prepared by Mr. John Daglish, of Seaham, was then read upon "the Mechanical Firing of Steam Boilers."

In the evening the President delivered his address, and we regret that our limited space precludes our giving a full report thereof, but the following are among the more important matters touched upon.

Sir William Armstrong said: "This year is the centenary of the steam-engine of Watt; and I am glad that it has fallen to the lot of Newcastle to receive, on so auspicious an occasion, a society which must regard Watt, more than any other man, as the father of their calling. First, then, I shall discharge my duty as your President by paying a tribute of respect to the memory of the illustrious man who, in the corresponding year of the last century, completed and set to work the greatest of mechanical inventions. In 1765, the authorities of Glasgow College, little thinking of the momentous step they were taking, entrusted a model of a Newcomen engine to James Watt, a maker of mathematical instruments, for repair. The sagacity of Watt enabled him, by an inspection of the model, to detect a radical defect in the principle of the engine. He saw that the condensation effected within the cylinder reduced its temperature, and rendered restoration of the wasted heat necessary at every stroke. He perceived that the steam ought to act in a vessel always hot, and be condensed in a vessel always cold. He thus conceived the idea of separate condensation. With a quiet tenacity of purpose he set to work, under great disadvantages, to realise his idea of a more economical steam-engine. His design was soon matured, but the difficulty of execution long remained a barrier to practical success. In the Newcomen engine, the weight of the atmosphere, acting against a vacuum, was the moving power, and leakage of air past the piston was prevented by water resting on the upper side. An unbored cylinder, made in separate parts, sufficed for this arrangement, but in Watt's design, steam instead of air acted on the piston; a water packing was inapplicable; and leakage could only be prevented by the more accurate fit of the piston in the cylinder. A moderately steam-tight cylinder and piston were, however, more than the workshops of the day could produce, and we read of his vain attempts to correct, by pasteboard and cork, inaccuracies of workmanship, such as in our time have no existence. With ailing health, narrow pecuniary means, and a temperament inclining to despondency, he was, in many respects, unfitted for a struggle with difficulty; but he was a man whose mind was taken captive by an idea, and he could not help persevering. His attractive character and fine intellect had attached to him many valuable friends, superior in station to himself, and his letters to some of those friends, written during his struggles, exhibit at once his severe discouragement and his irresistible impulse to proceed. In 1768 he had succeeded in producing a condenser with its necessary appendage of an air-pump, but it was not until the following year, 1769—exactly a century ago—that his first complete steam-engine was finished and put in motion. The first trial was made by Watt in a secluded glen, behind the house of his friend, Dr. Roebuck, near Linlithgow. The engine was not a mere working model, but a machine of considerable power. It had a cylinder of 18 inches in diameter, and a stroke of five feet; but the cylinder and piston, which were described as the best the Carron Ironworks could produce, were still so inaccurately made as to defeat, in a great measure, the anticipated success. The engine, however, afforded a practical demonstration of the value of the invention sufficient to lead eventually to the happy alliance of the capital of Boulton with the genius of Watt. In 1773, the engine was removed to Mr. Boulton's works at Soho, and was fitted with a new cast-iron cylinder, the casting and boring of which were deemed no small achievement in those primitive days of mechanical engineering. This first engine of Watt was, like that of Newcomen, only applicable to pumping, but Watt quickly saw by what modifications it could be rendered available for rotative motion. By a succession of brilliant inventions, comprising, amongst others, his parallel motion and his ball governor, he advanced to the final conception of the double-acting rotative engine, which became applicable to every purpose requiring motive power, and continues to this day, in nearly its original form, to be the chief moving agent employed by man. To do full justice to the genius of Watt, we must consider the disadvantages under which he laboured. In the present day, every contrivance is practicable in a constructive point of view, and the vast variety of devices used in modern mechanism, and applicable to new mechanical combinations, are made known to inventors in minute detail by the press. But Watt had no such facilities. He had to draw from his own mind what we can now choose from pre-accomplished invention, and his choice of means was restricted to the narrow limits of what was practicable in the rude workshops of the period. If we give due weight to these considerations, we shall be able to appreciate the remarkable originality of his mind, and the sagacity displayed in his invention. Watt lived to see his steam-engine bear fruit in marvellous utility to the human race; but he could have had no idea of the results it was destined to realise before the first century of its existence. It is impossible to contemplate these results without feelings of enthusiasm. To appreciate how much we owe to the steam-engine, we need only consider for a moment what our position would be if we were deprived of its agency. The factories which clothe all the nations of the earth would be almost extinguished. The deep mines which supply nearly all our mineral wealth would be abandoned. The manufacture of iron would shrink into comparative insignificance. Horses and sailing ships would again become our only means of transit. All great engineering works would cease, and mankind would relapse into that condition of slow and torpid progress which preceded the subjugation of steam by Watt. Having thus, in honour of an inventor whose name will grow greater as the world grows older, referred, in general terms, to engineering progress during the last hundred years, I need but glance at some of the more recent achievements in mechanical and constructive art, in order to show that the extraordinary advance of the century continues unabated. That such is the fact will at once be apparent, when I remind you that during the short period of eleven years, which has elapsed since the Institution of Mechanical Engineers last held their annual meeting in this town, the Atlantic Telegraph Cables, the Suez Canal, and the great railway across the American Continent, exceeding in length the sea passage from Europe to America, have been added to the engineering triumphs of the century. Of these, there is but one of which England can claim the glory, and that is the first successful Atlantic telegraph. The recondite science involved in that undertaking, the boldness of the enterprise, the perseverance displayed after the first failure, and the moral effects, as yet but partially developed, of its ultimate success, justify us in regarding the first Atlantic telegraph as one of the very greatest and most honourable achievements of man. But Englishmen may feel additional pride in reflecting that the successful laying of that cable, as well as of the subsequent French one, just now completed, was chiefly due to the fact that there had been previously completed in this country a steamship of such gigantic size as to be of itself one of the greatest wonders of modern engineering. Thus it is that one great invention hangs upon another. First came the steam-engine, then followed the great steamship, and finally the Atlantic cable, which, without the aid of steam, could never have been laid. The Suez Canal presents another example of the direct application of the steam-engine to the execution of one of the most remarkable of modern works, the chief part of the Suez Canal having been executed by steam dredgers, of which an interesting description was received by this institution at the Paris meeting. In contemplating this undertaking, we are naturally led to compare it with the great neighbouring relics of Egyptian antiquity. In quantity of material moved, the Suez Canal is far more vast than the great Pyramid. In its moral and intellectual aspects it is immeasurably superior. The ancient work is a useless monument of the idle vanity of a tyrant; the modern work will bear witness to the practical science and utilitarian spirit of our better times. Surely the world improves as the dominion of mind over matter is extended I should lengthen my observations too much if I were to review the many new and important applications of machinery and mechanical processes effected since our last meeting here. The manufacture of iron and steel—steam cultivation—mining operations—steam locomotion by land and water—economy of labour and of time—economy of fuel—printing—and even the humble business of the sempstress, have all been facilitated and promoted by recent mechanical progress. On the subject of coal, Sir William said he concurred in the probable accuracy of the announcement lately made by two of his fellow-commissioners, that the total quantity of coal in this island would prove to be practically inexhaustible; but until the complicated details of quantities collected by that Commission had been put together, and expressed in totals, it was difficult to judge with certainty or accuracy on the subject. Sir William went on to say that it was not to be supposed that future wars would be rendered more murderous by the intervention of the engineer; on the contrary, we might fairly anticipate that the more the element of intelligence supersedes that of animal force in military struggles, the more would the barbarity of war be mitigated. The most important of all the considerations affecting modern artillery is how to obtain the strongest possible tube with the least possible weight. Before I state my views as to the best mode of attaining this object, I must call attention to the conditions affecting the force to be resisted. When a charge of powder is fired in a gun, it is converted into gas at an exceedingly high temperature, and the pressure exerted is due, even in a greater degree, to the heat than to the quantity of gas produced. But the heat evolved is not wholly realised in augmentation of pressure, a considerable part of it being absorbed by the material of the gun. The heating of a gun by firing is an effect familiar to everyone, and it affords an indication both of the quantity of heat abstracted from useful effect, and also of the amazingly high temperature of the gas before it escapes from the gun. Fifty rounds fired in quick succession from a field-piece will make it so hot that it cannot be touched. Since the flame is only in contact with the bore for about the 150th part of a second at each discharge, it follows that the aggregate duration of the flame contact by which the gun is thus heated, in fifty rounds, only amounts to one-third of a second. The thin film of heated matter deposited on the surface of the bore at each discharge contributes, in

some measure, to this rise of temperature: but we may regard the acquisition of heat from this source as fully neutralised by the cooling of the gun in the intervals occupied by loading. Thus, then, you will be able to appreciate both the intensity of the heat of the gas and the extent of the waste by absorption. In small guns the area of absorbing surface surrounding the charge is greater in relation to the mass of the charge than it is in large guns. Therefore, the waste caused by the heating of the gun is also relatively greater, and the gas never attains either the same heat or the same pressure in the smaller weapon as in the larger. But the greater heat attained in a large gun adds to pressure not only directly, by expanding the gas, but indirectly, by accelerating the combustion of the powder. The powder must be regarded as fuel burning in a furnace, and the hotter the furnace is the quicker the fuel will burn. You will perceive, then, that the pressure of powder-gas per unit of surface is augmented by increasing the size of the gun, apart from all considerations regarding the projectile. But the pressure of the gas is further increased in large rifled guns by the great length of column represented by thin projectiles. The resistance increases with the length of the projectile, and the pressure rises with the resistance. Augmentation of pressure is also caused by the rifled projectile having to acquire motion of rotation in addition to that of translation, though the increase of resistance, and of consequent pressure, due to this cause, is not so considerable as is commonly supposed. For these various reasons, the introduction of the rifled principle, and the enormous increase of size demanded in modern ordnance, combine to intensify that pressure to a degree which taxes our utmost resources to control. The limit of the pressure actually reached in rifled guns of the largest size, when fired with English service powder, is not yet fully ascertained, but it is probably not less than seventy thousand pounds on the square inch. Now comes the question of what construction is best adapted to resist so inordinate a strain. It was long since demonstrated by Professor Barlow that a cylinder, to possess the greatest possible resistance to a bursting force, must, when out of action, have its interior in a state of compression and its exterior in a state of tension. He further proved it to be necessary that the internal compression should diminish in an outward direction and the external tension in an inward direction, up to an intermediate zone of neutrality. If these conditions were neglected, he showed that in a very thick cylinder the material forming the interior portion would be stretched to the breaking point before the exterior portion acquired any considerable tension. The interior, therefore, would be overstrained, while the exterior would be understrained, and the aggregate resistance would necessarily be less than if all parts were doing full duty. This reasoning is the foundation of the argument in favour of built-up guns, in which every layer of the material is stretched upon the layers beneath, and the finished structure is in the condition of internal compression and external tension, demonstrated by Barlow to be that of greatest strength. The Americans have endeavoured, with partial success, to realise the advantage of this principle in cast-iron guns, by cooling the inside first, and allowing the external portion of the metal to shrink upon the hardened interior. The Rodman cast-iron gun is made upon this principle, and, considering the nature of its material, has, in some examples at least, exhibited great power of resistance, though not sufficient to enable it to be used for heavy ordnance in the rifled form. Where forged material is used for the fabrication of guns, this condition of outward tension and inward compression is unattainable except by the application of the material in successive layers, each stretched on those below. Considerations of economy or convenience may supervene to reduce the number of layers, as in the Fraser modification of coil-made guns, but theoretical perfection will be most nearly reached in that gun which is composed of the greatest number of layers. To attempt to forge large guns in single blocks is a direct violation of established theory, and the general failure which has attended such attempts is a practical proof of the truth of the theory. The next point to consider is the best kind of material for the fabrication of guns. In determining this question, the choice clearly lies between steel and wrought-iron. I say this with no disparagement of Major Palliser's system of adapting cast-iron smooth-bore guns for rifling, by introducing a tube of coiled wrought-iron, but this method has, hitherto, only been applied with success to guns which, though formerly classified as heavy ordnance, are dwarfed by comparison with the ponderous guns of the present day. For these we require the greatest strength we can attain, and cast-iron cannot possibly be regarded as so efficient for enveloping the internal tube as either wrought-iron or steel. In discussing which of these two materials is best, I shall be trespassing on controversial ground. Krupp and Whitworth, both great names in gunnery, though differing widely in their views on other points, agree in this, that steel is the right material for the entire gun. I, on the other hand, have always advocated wrought-iron in the form of welded coil for the chief mass of the gun, limiting the use of steel to the internal tube, which has abrasion to resist as well as tensile strain. The expression of my opinions upon this point may probably not be considered impartial, but I will nevertheless state the grounds upon which my preference of wrought-iron thus applied is based. It has been found both in Elswick and Woolwich guns, that whatever failure takes place it almost invariably originates with that part which is made of steel. It is the steel tube which is nearly always the first to crack. So also, when the vent-pieces or closing blocks of the breech-loading guns were made of steel, their fracture was alarmingly frequent, but since wrought-iron has been substituted such occurrences are rare. The conclusion, therefore, at which I long since arrived, and which I still maintain, is that, although steel has much greater tensile strength than wrought-iron, it is less adapted to resist concussive strain. This conclusion is in strict harmony with the fact that armour-plates made of steel have proved, on every occasion of their trial, greatly inferior to plates of wrought-iron. The experiments which I made some years ago on the toughening of steel, in large masses, by immersion, when heated in oil, led me to expect that this fragility would be obviated by that process, and I felt sanguine that I should be able by such treatment to produce steel armour-plates of extraordinary resisting power. An armour-plate of steel was accordingly manufactured for experiment, and was tempered in a large bath of oil. Its quality was tried by test pieces cut off after tempering, and proved by tension and bending. The results showed a very high tensile strength, combined with so much toughness, that I was unable to match its bending power by any sample of iron I could compare with it. The plate was then sent to Portsmouth for trial, in the fullest confidence of success, but two shots from a 68-pounder sufficed to break it in various directions, and it was justly pronounced a failure. With these experiences before me, it is impossible that I can hold any other opinion than that the vibratory action attending excessive concussion is more dangerous to steel than iron; and were it not necessary to provide a harder and more homogeneous substance than wrought-iron for the surface of the bore, I should entirely discard the use of steel for the manufacture of ordnance. I do not mean to contend that very strong guns may not be made of steel, but I am convinced that failures will be more frequent, and, I may add, more disastrous, with steel than with iron, when the conditions of trial are the same. The want of uniformity in the quality of steel continues to be another serious objection to its use; and, in addition to all these considerations, the element of cost is greatly in favour of the wrought-iron coil construction over every mode of manufacture in steel. I will now offer a few remarks upon the interesting question of the probable future of guns. Upon the solution of this question depends the pattern of future ships, and also the policy of continuing or abandoning the struggle of armour-plates against guns. From my previous remarks on the increase of pressure with which we have had to contend as we have increased the size of our guns, it might be inferred that we were now nearly reaching a limit beyond which the strength and endurance of our material would not enable us to pass. I am not prepared to say how far we could have advanced under the recently existing conditions; but certainly every increase of size would have been attended with increase of difficulty. A new light, however, has just dawned upon the subject, which entirely alters the prospect. It has become apparent that the power which we have been using can be so modified as to produce the required effect with greatly less strain upon the gun. It may appear paradoxical that there should be a limit to the theoretical advantage of increasing the initial pressure of the gas evolved in the gun, but the apparent anomaly will disappear on examination. The action of expanding gas in a gun is analogous to that of expanding steam in the cylinder of a steam-engine; and we all know the advantage, in the case of steam, of having a high pressure to begin with, provided a steam jacket be used to maintain the material of the cylinder at a temperature equal to that of the entering steam. But in a gun we can have no provision analogous to the steam jacket, and it would appear that it is owing to the necessary absence of such a provision that there is a limit to the increase of initial pressure, beyond which no gain of propelling force is realised. Perhaps I shall not be fully understood without explaining this curious and important subject in a more definite manner, and I will therefore endeavour to do so. The force exerted in a gun bears a certain relation to the heat evolved by the gasification of the charge. The greater the heat the greater the force, for heat is nothing more than unexpanded force. I have already alluded to the loss of heat by transmission to the gun, and it is evident that this transmission must be greatest in amount when the heat of the gas is highest. By using a slower-burning powder, less heat and pressure are evolved at first, and the waste of heat in the stage of initial pressure being less, more heat remains for expansive action. Hence the slower-burning powder is weaker at first, but stronger afterwards, and although the total quantity of gas be only the same, and the pressure not so great at any point, yet the aggregate pressure throughout the bore may equal that of the more energetic and more dangerous powder. This would not be so if the gun, like the steam-jacketed cylinder, could be maintained at the maximum temperature of the elastic medium within. But in the case of the gun that temperature would be far above the melting point of its own material. It is only lately that attention has been strongly directed to the powder question in England. In Russia and Prussia, where great efforts have been made to obtain endurance with large rifled guns, powder similar in granulated form to that used in England has long been wholly discarded and superseded by powder stamped into prismatic blocks, which burn more slowly; but although we have erred in using a powder for our new ordnance, so violent as to be justly designated "brutal" by the French, yet we have this satisfaction, that the ordeal which our guns have sustained with our severer powder affords an assurance of strength which we could not have had if they had only withstood the mild description of powder with which alone continental guns have been successfully tried. Attention is now fully awakened to the subject, and a scientific military committee is conducting experiments upon the force of different descriptions of powder. In these experiments the pressures exerted in every part of the gun are determined, by the use of an instrument of exquisite delicacy, invented by my friend and partner, Captain Noble. This instrument, which is a happy combination of mechanical and electrical action, indicates the velocity attained by the projectile at any number of points in the gun, and from these velocities the pressures are deduced by calculation. Thus a diagram of pressure can now be exhibited for gas in a gun, as well as for steam in a cylinder; and I think you will agree with me in regarding this result as no small triumph of mechanical science. The mitigation of initial pressure, which is now known to be compatible with the maintenance of efficiency, opens a new future for guns, and removes all doubt as to the practicability of increasing their size and power to an extent which it would be vain to follow on the side of the defence by increase in the thickness of armour. No present armour-clad vessel is proof against present guns, and there is not the slightest probability that future armour will be proof against future guns. Ships of the *Warrior* class can already be pierced with shot or shell, fixed at considerable ranges, by even second-class guns, and the still stronger ships, now in course of construction, are pretty sure to be similarly overtaken in a very few years. Unless armour be invulnerable, it is of very doubtful advantage as a defence. It will, perhaps, prevent the entrance of shells, containing large bursting charges, but on the other hand the passage of a shot through the thick side of an armour-clad carries with it a mass of fragments that would act with terrible effect upon the crew. If we cannot stop a shot, the next best thing is to facilitate its passage through. Wooden ships are out of the question, because they are combustible, but we may have ships of iron without the armour. Whatever weight we carry as armour we lose as armament, and if we lessen the offensive power of a ship, by loading her with armour, we ought to be very sure that the armour will realise its defensive purpose. The efficiency of modern ordnance against armour-plates is

dependent, not only on the power of the gun, but also upon the material and form of the projectile.

At the close of the President's address, Captain Noble's apparatus for "determining the velocity of projectiles" in various parts of the bore of a gun was exhibited in the library of the Literary and Philosophical Society.

Three excursions were arranged for the 3rd ult., the first to Seaton Delaval, where nearly the whole of the company descended the Forster Pit. The party then visited the Ryhope Colliery, one of the most extensive mines in the County of Durham. Subsequently an excursion to sea was made on board the *Duchess of Sutherland*, a handsome new paddle steamboat intended for the passenger trade between Holyhead and Dublin, and built by Messrs. A. Leslie & Co. of Hebburn, for the London and North-Western Railway Company.

The congress resumed its sittings on Wednesday the 4th, in the theatre of the Literary and Philosophical Society, the President (Sir Wm. Armstrong, C.B.) again in the chair.

A paper by Mr. Percy G. B. Westmacott, of Elswick, was read by the Secretary, the subject being a description of the "hydraulic machinery for warehousing grain" at the Liverpool Docks. This was an extremely valuable and exhaustive memoir.

Mr. R. C. Clapham and Mr. Henry Allhusen having prepared a description of a revolving furnace for alkali works, the paper was now read by the Secretary, and explained by the authors with several coloured diagrams. It contained the following information respecting the apparatus:—The conversion of sulphate of soda into crude or hall soda is the third process conducted in alkali works, and its importance will be understood from the statement that in the Tyne district alone 455,000 tons and £560,000 represent the total annual quantity and value of the sulphate of soda, chalk, and coals operated upon in revolving ball furnaces. The revolving furnaces were introduced in 1853 by Messrs. George Elliot and Wm. Russell with the object of effecting by machinery that which from 1794 had been accomplished by hand labour; but owing to the numerous practical difficulties encountered the economy and other advantages expected were not realised, and no extensive application of the cylindrical furnace would yet have taken place had it not been for the perseverance of Messrs. Stevenson and Williamson, of the Jarrow Chemical Works, who made sundry improvements on the original plan, and erected five of the fifteen revolving furnaces now working in England. In this description of furnace the charge of material to be acted upon is placed in a revolving cylinder—constructed of five-sixteenths boiler plates lined with fire bricks—and mounted so as to allow the heat from the furnace at one end of the cylinder conveniently to pass through it, and over the liquid contained in the evaporating pan at the other end. In exterior measurement the cylinder is 15ft. 6in. long and 9ft. in diameter, the interior measurement being 13ft. 3in. in length, and 7ft. 6in in diameter in the centre, and 6ft. 6in. diameter at either end. In the brick lining are fixed two rows of fireclay blocks, termed "breakers," which stand 14 inches above the lining in the centre, and 9 inches at the ends; by these the contents are thoroughly mixed, and successively exposed to the fire. Between the furnace and cylinder a loose collar is adjusted which consists of a wrought-iron hoop lined with fire brick, and between the pan and cylinder at the other end a space is left termed the smoke chamber, so that the greater part of the materials carried forward by the strong draught may be deposited there instead of in the liquid to be evaporated. In the downcast at the extremity of the pan a main or horizontal damper is chained, so that no more than the requisite draught can be taken, further control being given by a vertical damper placed between the pan and downcast, and counterbalanced by a weight suspended near the engine. The accompanying diagrams explain that the mechanical apparatus rests on a bed-plate 2¼ inches in thickness, cast in five pieces fastened together by six wrought-iron hoops shrunk on; the whole being secured to the stone foundation by twelve 1¼-inch bolts. The vertical direct-acting engine, with reversing link motion, has a vertical cylinder 9 feet in diameter working at 6-horse power, with 30 lbs. pressure. The cylinder of the furnace makes one revolution per minute when in the quick motion, and one per five minutes when in the slow motion. The quick motion is obtained direct from the crank through the upper line of shafting, upon the end of which a worm is attached working into a worm-wheel fixed to the pan end of the cylinder by means of feet and screw bolts. In some cases these worm-wheels have been cast in segments, but on account of their inaccuracy and the difficulty experienced in getting the pitch of the teeth correct at the joints, one casting is deemed preferable. The slow motion is obtained by disengaging the friction cone on the upper shaft, and putting into gear the lower shaft, so that the spur-wheel and pinion at either end of the latter work into the pinion and spur-wheel in the former. To the furnace cylinders are riveted two cast-iron rings, each strengthened by two wrought-iron hoops 1¼ inch square. On each ring is contracted a malleable iron tyre, which runs on two cast-iron flanged-bearing wheels, with 4½-inch axles supported on diagonal carriages. In some instances the cylinder ring tyres have been contracted on in one piece by boring out the tyres and turning the rings, but expansion and weight sooner or later causes the tyres to become loose, and consequently to snap the bolts. For this reason it is advisable to fix the wrought-iron tyre in segments with diagonal face joints, and to have the countersunk bolts passed through an oblong hole in the cast-iron ring, by which means expansion is allowed for and the breaking of the bolts prevented. The charge of the furnace consists, at Messrs. Allhusen & Sons' works, of sulphate of soda, 22 cwts.; chalk, 25 cwts.; and coal, 12 cwts. The sulphate of soda falls through a half-inch screen as delivered into its depôt, and thus an adequate quantity of "fine" is secured for the cylinder without expense. The chalk is charged in moderately sized blocks, whilst the coals are divided—3 cwts. being mixed with the sulphate and 9 cwts. with the chalk. On the day shift, when the pan is drawn, five charges are worked; on the night shift six—a full work being six days at 12 tons 2 cwts. sulphate of soda per 24 hours, making 72 tons 12 cwts. per week. The method of proceeding is as follows:—In the first place the 25 cwts. of chalk and 9 cwts. of coal are charged, and the cylinder is made to revolve with the slow motion. After the expiration of one hour and ten minutes the conversion of the chalk into lime, or "liming," is generally effected, and is always indicated by a bluish flame round the charging door. When the 22 cwt. of sulphate and 3 cwts. of coal are added, the vertical damper is then lowered for ten minutes, so as to give the smallest possible amount of draught. In about twenty minutes after the vertical damper has been raised the fluxing of the sulphate becomes apparent by the escape of a bright yellow flame round the charging door, when the workman at once changes the motion from slow to quick. A small door in the arch over the pan enables him to ascertain when the decomposition of the materials is sufficiently advanced, which he judges by their clear colour and increasing consistency, as also by the light yellow jets of flame that issue from portions of the fluxed mass adhering to the breakers. This stage is usually attained in half an hour, when the contents are run out; the total time expended on each operation amounting, on the average, to two hours ten minutes.

A very voluminous paper, prepared by Mr. Max Eyth, of Leeds, was afterwards submitted, "On towing boats on canals and rivers by a fixed wire rope and clip drum." The subject was profusely illustrated by coloured diagrams of very great size.

The members, through the kindness of the several proprietors, were enabled to visit many of the most important iron, engine, rope, carpet, and other works in Newcastle, Gateshead, and district; and also a number of collieries.

Thursday the 5th ult. (the meeting for the reading and discussion of papers having terminated on Wednesday), was spent by the members in excursions to various places of interest upon the Tyne.

The first party of excursionists started from the quay at about half-past nine o'clock, on board the Tyne General Ferry Company's steam-tug *Margaret*. Under the guidance of the Assistant-Secretary of the Institute, they visited many of the most important and extensive works on Tyneside. After a nice run down the river, they inspected the Tyne Commissioners' repairing yard at Hebburn, and then, crossing to the south side, they were conducted into Palmer's shipbuilding, engine, and ironworks. Being met on the quay by Mr. McIntyre and a numerous staff of assistants, the party divided into sections for greater convenience, and then commenced their exploring at the west end of the works, near the blast furnaces. They were first shown the beautiful double engine, by Lilleshall, of Shropshire, erected for the purpose of getting a current of air to the blast furnaces; and thus early must have had a foreshadowing of the wealth of the place by the magnificent manner in which the engine is fitted. Her beams were supported on massive pillars, painted in imitation of marble, and the floor, the walls, and ceiling were finished with corresponding excellence. She was said to be of 260 horse-power, 45 feet beam, 9 feet stroke, and to make 13 or 14 revolutions an hour; while her small cylinders were 48 inches in diameter, and her blowing furnaces about 100. The four furnaces to be operated upon by this monster engine stood in a line alongside, and their excellent fittings and arrangements were deserving of all admiration. They were said to be able to produce from 18 to 20 tons of metal every 12 hours, having the Cleveland trap apparatus applied at the summits; and therefore, in order to see the effective working of this arrangement, many of the engineers ventured up the very steep incline on which the coke and ironstone are conveyed, and submitted, in order to satisfy their curiosity, to be nearly roasted by the tremendous sheets of flame which escaped whenever the fuel was inserted. From this place a move was made to the puddling furnaces, where half-naked men dealt with the molten metal, there being here forty-eight or fifty furnaces in active operation, and the workers turning out 130 tons of the puddled iron every day of 24 hours. The process of purifying and solidifying the rough balls under the hammer, its subsequent passages through the rolling-mills, and its preparation into rails and plates, were also shown; but nothing gave greater pleasure and gratification to the visitors than the magnificent machinery by which the mills were kept in motion, and the cutting operations performed. Great interest, too, was manifested in the erection of the two war vessels, *Swiftsure* and *Triumph*, which are now rapidly progressing, for the British Government. They are both vessels of about 3,800 tons each, 280 feet long, 55 feet broad, and 34½ feet deep. A massive sheer leg crane, erected on the quay, was proved during the afternoon to lift 100 tons. About 5,000 persons are employed in the yard. Altogether, the works were in full play, and afforded one of the best illustrations of the resources of Tyneside that could possibly have been afforded.

Messrs Tennant's Chemical Works were next visited. These fine buildings are situated on the south bank of the Tyne, and occupy an area of about six acres. Every department was open to the inspection of the visitors, and, as a competent guide was provided, the peculiarities of the various processes used in the manufacture of soda ash and soda crystals were clearly and lucidly described. The crusts of several of the crystallising pans were here broken for the gratification of the company, and the jets—resembling beautifully cut and polished glass pendants—elicited the admiration of all present. The whole of the engines about the place are worked by hydraulic power, and these, together with the other appliances, enable the owners to produce weekly a quantity of 200 tons of soda ash, and 150 tons of soda crystals, the only articles manufactured in the works.

Shortly after six o'clock the members once more embarked, and were run down to Hebburn Quay for an inspection of the extensive machinery for raising water out of the flooded coal fields of the district.

From this spot the engineers were conveyed to the Tyne Commissioners' dredgers at Bill Point, and afterwards to the works in connection with the swing bridge at Newcastle; where they eventually landed, after a very interesting twelve hours' journey, shortly after nine o'clock.

A party of Mechanical Engineers, numbering upwards of thirty, left Newcastle quay, on board the *Robert Chambers*, for the purpose of inspecting the two bridges in course of construction, Messrs. Allhusen and Co.'s extensive chemical works, the Tyne Commissioners' Yard, and the pumping operations in progress at the Wallsend Colliery.

The steamer left the quay about ten o'clock, and proceeded up the river for the purpose of enabling the company to inspect the Redheugh Bridge Works. These were reached in a few minutes, and no one connected with the works being present, Mr. McAllum, of the Tyne Commission, very obligingly gave the Engineers the benefit of such information as he possessed respecting the bridge. It was noticed

that in the centre of the river four stone piers had been erected upon the concrete and brickwork with which four iron cylinders (which had been successfully sunk to a depth of 38 feet below low-water mark) had been filled. The cylinders being sunk two feet below low-water mark are not at any time visible, and the piers of masonry have the appearance of rising from the bed of the river. They are slender, and in perfect keeping with the lightness and elegance of the whole design of the bridge. The diameter of each is three feet, and they are to rise to a height of about eighty feet, at which elevation they will sustain the girders which will span the river. The question was raised whether such apparently unsubstantial pillars could resist the force of the current and of the ice to which they must be at times exposed, but it was explained by Mr. McAllum that, in compliance with the requirements of the Tyne Commissioners, they would be completely protected with frameworks of wooden fenders or guards, consisting of double rows of piles, and presenting a sharp angle, which would act as a cutwater to the current. The four columns, so far as they have been placed in position, are braced together and strengthened by diagonal tie-rods. The cylinders of the south pier are already *in situ*, and the stone pillars are in the course of building, while the cylinders forming the north pier are now being sunk. The approach on the north side is considerably advanced, and seven inches of twenty-five feet span, each of which sustains the structure at its proper level down the bank of the river, are finished. The three arches on the south side have not made like progress, and will take some time to complete. The staging for erecting the girders, and throwing over the roadway, are being raised; two have been built up to the requisite height. The length of the bridge will be about 1,400 feet. The road will have 87 feet headway of high-water mark, being three feet higher than the High Level, and the entire height of the piers will be 152 feet. The width of the roadway will be 20 feet, and of the footpaths, which will be formed outside the girders, seven feet six inches each. The works were begun in June 1868, and have progressed with fair rapidity; the time in which the bridge was expected to be opened for traffic was within two years from the commencement of the work.

Messrs. Allhusen's Chemical Works were next inspected.

The new swing bridge now in course of erection between Newcastle and Gateshead was next visited. About forty of the members accompanied the excursion, the arrangements for which were generally under the care of Mr. Bunning, and during the day the company included Sir William G. Armstrong, Mr. Ald. Cowen, M.P., Mr. Bramwell, Mr. Ure (engineer to the River Tyne Commissioners), &c.

The Docks and Great Dredger were also visited and examined.

## INSTITUTE OF FRANCE.

M. Balard communicated to the Institute early this year, in the name of M. Emile Duchemin, more ample details of his new method of producing vitrified photographic proofs. The enamelled glass, which is used in this form of photography, is ordinary glass, but of the most fusible sort, covered with the following enamel: arsenious acid, 30 grammes; saltpetre, 30 grammes; siliceous sand, 90 grammes; litharge, 250 grammes. This glass possesses the precious property, that on its surface what we please can be written or drawn as fluently as on paper, and it is sufficient then to put it (the glass) for a few minutes into an open furnace or muffle, in order to make the writing unalterable. Autographs, administrative documents, labels for plants and trees in botanic gardens etc etc. can be thus made easily indelible and practically unalterable. In order to apply this glass to photography, it is necessary to smooth and polish its surface by a simple grinding, so as to produce a better contact all over with the stereotype. If the grinding has left the enamel sufficiently polished, the photographic impressions will be of a very great fineness and delicacy. Enamelled glass of this sort, ground in the best possible manner, is, we believe, to be had of M. Puech, 21 Place de la Madeleine, Paris.

It can be operated upon either in the dark chamber or on a simple negative or positive stereotype; and any one of the sensitive photographic agents or substances can be used upon it, such as bitumen of Judea, perchloride of iron, tartaric acid, or bichromate of potash. As may be supposed, the latter substance has been chosen. The following solution is prepared: water, 100 grammes; gum, 3 grammes; honey, 1 gramme; crystallised bichromate of potash, 2 grammes. This solution is spread on the enamelled glass and then dried. It is exposed to light, and developed by means of a brush and the following powder: oxide of cobalt, 10 grammes; black oxide of iron (*oxide ferroso ferrique*), 90 grammes; red lead, 100 grammes; sand, 30 grammes. The bichromate of potash is decomposed by plunging the developed proof into a bath composed of—water, 100 grammes; hydrochloric acid, 5 grammes. The proof is then washed in pure water, dried, and next vitrified on a flat and smooth cast-iron plate covered with a coating of chalk, so as not to deform the enamelled glass. One minute in an open furnace or muffle, at a sufficient heat, is enough for fixing and glazing the proof, which is afterwards cooled with the same precautions as in the case of enamels on copper. It will be seen that this process, if skilfully managed, can be extended to large plates of enamelled glass, and that it therefore can be applied for the production of large vitrified photographs.

Some of these beautiful productions, the advent of which we take credit to ourselves for having anticipated in the pages of this Journal two or three years back, were exhibited in the late Exposition des Beaux Arts, in the Palaise de l'Industrie at Paris. That it will be applied, as we suggested, to portrait photographs in coloured glass windows, upon the grand scale, before very long, we cannot doubt.

# MONTHLY NOTES.

Range Experiments for Field Artillery at Shoeburyness.—Some time since we recorded the first trial of an interesting system for ascertaining the distances of objects in the field by instrumental means devised by Lieutenant Nolan, R.A., as against the ordinary system in the service of judging the distances by eye alone. Since then other instrumental means have been proposed by other officers and by opticians; and recently a competitive trial between several of such instruments designed to ascertain rapidly distances for artillery purposes was made at Shoeburyness, under the direction and in the presence of the Commandant, Colonel Elwin, R.A.

Four telemeters constructed upon different principles were employed. The first, made by Mr. Elliot, is a telescope containing micrometer cross wires; one of these is fixed, the other movable. The man whose distance is desired being brought within the field of the telescope, the fixed wire is seen in line with his feet, and the movable wire is made to appear to touch his head; this latter movement is effected by a ring round the small end of the telescope, which is graduated in yards, so that as soon as the wires are properly adjusted the range may be read off at once. Another scale gives the distance of a horseman. The second system is that of Colonel Clerk, R.A. It may be said to consist of two very powerful and much aimplified sextants, which are worked at each end of a base of 100 yards. The mean of the angles which they give being ascertained, a table shows the distance.

The third instrument has been invented by Mr. Adie, and has already been used by surveyors and sportsmen. A metal case, one yard long, contains two telescopes, of which the object-glasses are at the extremities, and their common eye-piece in the centre; two pair of prisms bend the rays of light, so that from the two ends they reach this common eye-piece, which has one of its glasses cut in halves. When the two telescopes have been made by a small handle to converge on any object, a single image is seen in the eye-piece; when they do not so converge a double image is discerned. A scale divided very finely to two seconds shows how much the handle has moved the interior of one of the telescopes; and corresponding to the small angles read off on this scale are the distances shown on an ivory tablet affixed to the instrument.

Lieutenant Nolan employs two guns, on which are affixed cross telescopes; the distance between the guns was for the first five cases 57, and for the remainder 93 yards. By a system of mechanical calculation, or modification of sliding rule, he combines the base and base angles so as to give the range.

To test these various instrumeuts a mounted sergeant was sent along one of the lines of pegs, which mark the distances from the several batteries at Shoeburyness, and whenever he halted his distance was estimated by the different systems, the answers being given to Capt. Alderson, R.A., assistant-superintendent of experiments, and afterwards compared with the true position of the sergeant. Mr. Adie manipulated his own telemeter; Lieut. Ellis, R.A., that of Mr. Elliot; Mr. Butters, of the Royal Carriage Department, Woolwich, Colonel Clerk's; and a party of gunners, under the superintendence of Lieutenant Nolan, that of the latter gentleman. The results are given below:—

| True Distance | Errors | | | |
|---|---|---|---|---|
| Yards | Adie. Yards | Clerk. Yards | Elliot. Yards | Nolan. Yards |
| 865 | 71 | 6 | 15 | 2 |
| 1,200 | 0 | 19 | 10 | 4 |
| 1,619 | 19 | 35 | 149 | 15 |
| 1,900 | 12 | 48 | 190 | 6 |
| 2,558 | 156 | 104 | 158 | 24 |
| 2,706 | 244 | 107 | 6 | 8 |
| 3,452 | 231 | 300 | 352 | 22 |
| 3,380 | 147 | 217 | 480 | 26 |
| 3,802 | 164 | 115 | 1,002 | 8 |
| 3,040 | 93 | 160 | 240 | 4 |
| 2,717 | 133 | 160 | 517 | 17 |
| 2,354 | 154 | 84 | 154 | 7 |
| 1,975 | 95 | 40 | 95 | 25 |
| 1,640 | 80 | 29 | 120 | 9 |
| 1,205 | 31 | — | 25 | 19 |
| 944 | 8 | — | 16 | 6 |

Notices as to Steel.—Dr. Dav. Forbes examined cementation steel, which had been manufactured at Sheffield of Swedish bar-iron, and found its constitution:

| | |
|---|---|
| Carbon, in chemical combination | 0·627 |
| Carbon, graphitoid | 0·102 |
| Silicon | 0 030 |
| Phosphorus | 0·000 |
| Sulphur | 0·005 |
| Manganese | 0·120 |
| Iron | 99·116 |
| | 100·00 |

Much cast-steel, it is stated, is now made at Sheffield, not from Swedish bars at all, but by melting up Bessemer bars in crucibles. In view of this, Dr. D. Forbes's analysis of the blister steel made by cementation from Swedish bars is interesting. He records no phosphorus whatever, which is remarkable; but the iron appears to have been taken as residue, for the analysis shows *no loss*.

Kirchweger gives the following review of various sensible qualities of the different sorts of steel and iron:—

*Cast-steel* shows a fine-grained and most regular fracture, hardens by sudden cooling, contains from 1·5 to 1·75 per cent. carbon, and possesses 183 lbs. absolute resistance per square millimetre.

*Puddled Cementation, or Blister steel*, welds and hardens, contains from 0·66 to 0·49 per cent. of carbon; absolute tensile resistance 128–199 lbs.

*Bessemer-steel* is fit for welding, hardens very little, is very flexible, fine-grained in the fracture like cast-steel, and contains from 0·51 to 0·65 per cent. of carbon; absolute tensile resistance 111–150 lbs.

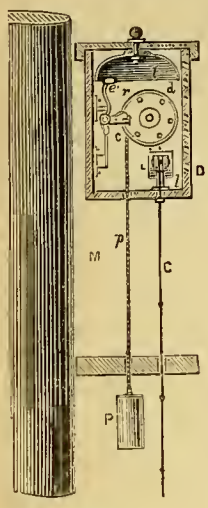
*Fine-grained iron* is fit for welding, shows a fine-grained fracture, does not harden, and contains from 0·51 to 0·65 per cent. carbon; tensile resistance between 70 and 117 lbs.

*Boiler-plate iron* is fit for welding, does not harden, shows a fibrous harsh fracture, and contains between 0·50 and 0 65 per cent. carbon; resistance 66 lbs.

These comparative statements must only be taken for what they are—mean deductions from German manufacture.

ALARUM TO INDICATE THE RISE OF WATER IN A SHIP'S HOLD.—M. F. de Coninck, shipowner, of Havre, has been led, by recent accidents which have occurred from the entrance of water into ships' holds not being discovered until the pumps are of no avail, to design an apparatus for the purpose of indicating by an alarum the rise of water in the hold of a vessel, both by night and day, and whether at sea or in port. The principle of the apparatus is that of a float in communication with an alarum-bell provided with a ratchet and detent arrangement and counter weight, which, in their normal condition, maintain the apparatus in equilibrium, but, as soon as the float rises by the ascent of water in the hold of the vessel, the equilibrium is destroyed, and the alarum set in motion. This apparatus is illustrated by the annexed engravings. It consists of an open box A, which is placed in the well, near the *carlines*, and is perforated at the bottom to admit of the inlet of the water in order to enable it to raise the float. B is the float suspended by a chain C, which is carried up through the between-decks and the deck into the box D, which is fixed to the mainmast M and contains the alarum. The alarum apparatus is composed of a bell *t* attached to the cover of the box, and a conical roller *r*, which is provided at its larger end with a disc *d*, carrying six projecting pins, and at its smaller end with a cam *c*, having four ratchet teeth formed in it with which one extremity of the lever L which is jointed to the forked support *l* engages. The chain C is attached to the lever at one end, and at its opposite end engages with the cam; the latter with the conical roller is prevented from turning so long as the float B is in its normal position. When, however, the float ascends by the inlet of water into the box A the lever L is released from the ratchet teeth, which causes the roller to turn under the action of the weight P, which is suspended at the end of a cord *p* wound on the roller. At every turn of the roller the six projections on the disc *d* act upon a spring lever *e*, provided with a hammer *e'*, which strikes the bell, the number of strokes of the hammer being limited by the depth of the hold. The weight P, when it has run down, may be wound up again by turning the roller by means of a handle after the water has been pumped out of the vessel. A model of this apparatus was exhibited at the Havre Maritime International Exhibition.—*Le Génie Industriel.*

Fig. 1.



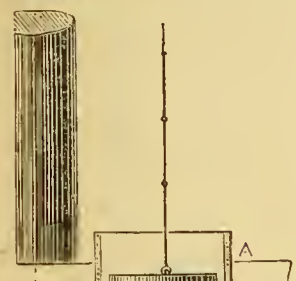
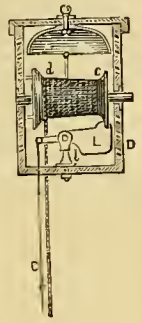




Fig. 2.




STEAMSHIP BUILDING ON THE CLYDE.—Messrs. W. Simons and Co., of Renfrew, have launched an iron screw of 700 tons, named the *Africa*, built for the Spanish Steam Navigation Company, and intended to trade between Spain and Teneriffe. The *Africa* is fitted with a pair of the builders' compound engines of 150-horse power. Messrs. J. and R. Swan, of Kelvindock, have launched two small screws of 70 tons burden, named respectively the *Pioneer* and the *Shamrock*, and intended for the fishing trade. Messrs. Denny Brothers, of Dumbarton, have contracted to build for the Austrian Lloyd's Steam Navigation Company two steamers, to be named the *Apis* and the *Sphinx*. These vessels are to ply between Trieste and India *viâ* the Suez Canal. The burden of each will be 1,400 tons. A large Spanish screw, the *Isla de Cuba*, of 2,500 tons burden, has arrived at Dumbarton from Santander. She is one of the Spanish line of Havannah mail-packets, and is a Belgian-built vessel. She has been sent to Messrs. Denny, of Dumbarton, for a general overhaul and to receive new boilers. Messrs. A. and J. Inglis, of Pointhouse, have launched an auxiliary screw clipper, named the *Oberon*. This vessel has been built to the order of Messrs. Shaw, Maxton, and Co., of London, and will form one of their China fleet. With the view of avoiding the detention occasioned by calms in the equator to sailing vessels, she has been fitted with machinery by which she will be enabled to keep up a uniform speed throughout her voyages. Messrs. Napier have launched from their yard at Govan the *Invincible*, a twin screw armour-clad frigate, built for the British Government. The frigate is a twin vessel to the *Audacious*, launched by Messrs. Napier in February. She has been built from the designs of Mr. Reed, and her dimensions are—Length between perpendiculars, 280ft.; extreme breadth, 54ft.; depth moulded, 36ft. Her burthen is 3,774 tons old measurement. Her armament is intended to consist of ten 12½-ton guns and four 64-pounders. The *Invincible* is the fifth armour-clad which Messrs. Napier have built for the British Government.

## APPLICATIONS FOR PROVISIONAL PROTECTION FOR INVENTIONS UNDER THE PATENT LAW AMENDMENT ACT.

☞ When the city or town is not mentioned, London is to be understood.

*1st July* 1869

1977 A. Walker, Heriot, Mid Lothian, N.B.—Agricultural implements
1978 W. E. Gedge, Wellington Street, Strand—Safety break for railway vehicles.—A com.
1979 R. W. Whitehead, Ashton-on-Mersey, Chester—Coupling or jointing pipes or tubes
1980 W. Coleman, London, and S. Turton, Heaton Norris, Lancaster—Feeding bottles
1981 R. Porter, Birmingham—Furnaces
1982 T. Atwater, Paris—Band for ladies' wear
1983 J. Stringfellow, Chard, Somerset—Apparatus for affording protection from bullets and other missiles
1984 J. D. Dougall, St. James's Street, Westminster, and W. Bartram, Sheffield—Apparatus for filling cartridges
1985 J. H. Johnson, Lincoln's Inn Fields—Breech-loading fire-arms.—A com.
1986 A. Barclay, Kilmarnock, Ayr, N.B.—Motive-power engines
1987 L. F. Banks, Kilmainham, Dublin—Markers for the game of croquet
1988 A. V. Newton, Chancery Lane—Improved manufacture of nail or spike.—A com.
1989 A. Turner, Leicester—Utilizing waste strips of indiarubber
1990 H. Larkin, Torriano Cottages, Leighton Road, and W. White, Thurlow Road, Hampstead—Production of sodium and potassium
1991 E. Roe, Nottingham—Manufacture of looped or knitted fabrics

*2nd July* 1869.

1992 T. Jones, Handsworth, Stafford—Attaching or uniting together the body and barrel of repeating firearms
1993 H. A. Bonneville, Sackville Street, Piccadilly—Billiard and bagatelle-room convenience.—A com.
1994 H. A. Bonneville, Sackville Street, Piccadilly—Motive power.—A com.
1995 E. Scott, Manchester—Weighting motions used in machinery for preparing, spinning, twisting, and doubling fibrous materials.—A com.
1996 S. Smithson, Heckmondwike, York, and G. Senior and J. Inman, Brighouse, York. Valves or valve taps for regulating the discharge or flow of water or other fluids or gases
1997 S. Brooke, Brighouse, York—Apparatus for carding and otherwise preparing wool or other fibrous substances for spinning
1998 G. White, Queen Street, Cheapside—Rotary steam-engine.—A com.
1999 C. D. Abel, Southampton Buildings—Preparing corks for rendering them impermeable under the action of wines and other liquids, either when charged with gases or not.—A com.
2000 H. Turner, jun., Leicester—Weaving plain and elastic terry fabrics
2001 W. Frazer, Newcastle upon-Tyne—Preparation of materials for fettling or lining puddling furnaces
2002 W. R. Lake, Southampton Buildings—Combined travelling bag and chair.—A com.
2003 J. Smithers, Dublin—Galvanic batteries
2004 W. A. Biddell and J. Redgrave, Birmingham—Manufacture of ornamental articles in glass alone, or in combination with other materials, and in the application thereof to various purposes
2005 A. V. Newton, Chancery Lane—Preparing flax, hemp, and other fibres, and in converting the same into slivers.—A com.
2006 H. E. Newton, Chancery Lane—Meters for measuring liquids.—A com.
2007 J. Steward, Wolverhampton—Pianofortes
2008 A. Foucaut, Orleans, France—Telegraphic cables

*3rd July* 1869.

2009 P. G. Gardiner, New York, U.S.—Springs for railroad cars, buffers, &c.
2010 N. Mole, Calvert Street, Shoreditch—Boots and shoes
2011 A. Angell, Rio Janeiro—Machinery for hulling and polishing coffee, rice, and other berries or seeds
2012 A. H. A. Durant, Avenue Road, Shepherd's Bush—Preparing or treating castor and other oleaginous seeds or berries for the manufacture of oil
2013 T. Grahame, Leamington—Construction of barges, boats, floating batteries, &c.
2014 I. James, Cheltenham—Apparatus for crushing or breaking stones, bones, &c.
2015 G. Palmer, Reading—Manufacture of biscuits
2016 J. Hart, Leamington—Apparatus for separating, distributing, and utilising sewage
2017 T. Butler and R. F. Carey, Nottingham—Manufacture of lace made on bobbin-net or twist-lace machines
2018 C. Churchill, Hackney—Implement for drawing nails.—A com.

*5th July* 1869.

2019 J. Clark, Paisley, N.B., and A. Ewing, Glasgow, N.B.—Feeding steam boilers or generators
2020 T. Smith, Birmingham—Utilising the waste heat of puddling and ball furnaces for the calcination of cinder into bulldog for furnace fettling
2021 W. Duckworth, jun., Liverpool—Taps for general purposes
2022 F. W. Grüne, Berlin—Transferring photographs to wood, metal, ivory, and other surfaces
2023 T. Wilson, Birmingham—Velocipedes
2024 W. R. Lake, Southampton Buildings—Water-meters.—A com.
2025 L. Falisse, Liège, Belgium—Breech-loading firearm
2026 W. E. Newton, Chancery Lane—Manufacture of bar iron.—A com.
2027 J. Knight, Huntingdon—Four-wheeled vehicles

*6th July* 1869.

2028 G. Buchanan, Surrey Street, Strand—Preserving animal and vegetable substances for use as food
2029 W. B. Haigh, Oldham—Apparatus for cutting, sawing, and boring wood

2030 J. Gedge, Wellington Street, Strand—An arm and reclining chair for travellers—A com.
2031 C. D. Abel, Southampton Buildings—Machinery for composing and distributing type.—A com.
2032 W. Walker, Dundee, N.B.—Motive-power engines, rotary pumps, and fans
2033 W. L. Wise, Chandos Chambers, Adelphi—Apparatus for lubricating the cylinders of steam-engines.—A com.
2034 C. Croekford, Amlwch, Anglesey—Treating the ores of lead or products containing lead, either isolated or in combination with other metals or minerals, for the purpose of producing metallic lead and other metals and their compounds
2035 C. E. Brooman, Fleet Street—Apparatus for heating and distilling water for boiler and other purposes.—A com.
2036 L. and L. Clayton and J. Smith, Hunslet, Leeds—Taps or valves
2037 W. Bray, Stockton, New Jersey, U.S.—Refrigerators, more especially designed for railway provision carriages
2038 W. Q. East, Drummond Street, Euston Square—Indicating or registering the flow of liquids or fluids from vats, casks, &c.
2039 W. Pidding, Walcot Square—Obtaining scents, aroma, perfume, or essential oils from flowers

*7th July* 1869.

2040 J. Shore, Rochdale—Cards used in carding engines
2041 D. Cope, Liverpool—Apparatus to prevent waste of liquids in filling casks
2042 H. E. Knight, Love Lane, Wood Street—Busks for stays, bodices, gaiters, &c.
2043 F. Walton, Staines—Scrapers for removing mud from boots and shoes whilst in
2044 J. B. Rogers, Hastings—Velocipedes
2045 V. A. Deaubeuf, Maindy, Cardiff—Apparatus for compressing and moulding small coal. &e.
2046 A. P. Price, Lincoln's Inn Fields—Producing partial or complete anæsthesia.—A com.
2047 R. Mallet, Victoria Street—Manufacture of iron and steel
2048 F. Trappes, Paris—Velocipedes
2049 J. Robinson, Rochdale—Machinery for cutting dovetails
2050 W. E. Newton, Chancery Lane—Converting or puddling furnaces for decarbonising iron.—A com.
2051 W. Arnold, Barnsley, York, and W. Carnelley, Fallowfield, near Manchester—Improvements applicable to steam boilers
2052 A. V. Newton, Chaneery Lane—Chandeliers.—A com.
2053 W. R. Lake, Sonthampton Buildings—Removing artificial coatings from metallie surfaces.—A com.
2054 J. H. Johnson, Lincoln's Inn Fields—Improvements in the preparation of meat for preservation, and in the preservation of the same.—A eom.
2055 R. P. Faucheux, Poultry—Boxes or holders for matches and other articles

*8th July* 1869.

2056 C. S. Berthon, Margaret Street, Cavendish Square—Squares for finding the centre of circles and marking the outlines of regular or irregular figures thereon
2057 J. G. Rollins, Old Swan Wharf, Upper Thames Street—Reaping and mowing machines.—A com.
2058 J. Wright, Moorgate Street.—Shaving mng.—A com.
2059 W. Davis, Merthyr Tydvil—Treatment of tallow used in the manufacture of candles and soap
2060 T. Knowles, Birmingham—Wrought-iron permanent way for railways
2061 I. Williams, Birmingham, and R. C. H. Wallendahl, Bergen, Norway—Machinery for the manufacture of fish-hooks.—A com.
2062 I. L. Pulvermacher, Regent Street—Constructiou of chains, batteries, and apparatns for prodncing electric currents

*9th July* 1869.

2063 W. Hntchinson, Salford—Manufacture of bricks and other articles of clay
2064 H. H. Murdoch, Staple Inn—Propelling canal boats and other vessels.—A com.
2065 T. James, Liverpool—Sewing machines
2066 F. Baker, Kennington—Opening, elosing, and securing railway level-crossing and other gates
2067 J. H. Jones, Field Terrace, New Wandsworth—Lamps
2068 M. A. Muir and J. McIlwham, Glasgow—Looms
2069 J. Aitken, Lasswade, near Edinburgh—Obtaining motive power
2070 G. A. Nowell, Nnneaton, Warwick—Lamps
2071 F. J. Manceaux, Paris—Improvements in breech-loading firearms and in cartridges for the same
2072 W. Allen and P. D. Nichol, Sunderland—Steam generators or boilers for marine purposes

*10th July* 1869.

2073 A. M. Clark, Chancery Lane—Measnring or dividing time.—A com.
2074 J. W. Jackson, Brighton—Breakwaters, sea defenee walls or entrances for docks, and docks
2075 J. Walker, Mansell Street, Aldgate, and P. A. Godefroy, Templer Road, Homerton—Dyes or colonring matter
2076 C. E. Brooman, Fleet Street—Central-fire cartridges.—A com.
2077 J. Gessert, Elberfeld, Prussia—Reeovery of nitric acid in the manufacture of sulphuric acid
2078 T. Kendrick, Birmingham—Knobs for bedsteads, door handles, &c.
2079 T. D. Waller, Palace Square, Norwood—Self-acting measuring and tilting cask stand
2080 C. L. Caldesi, Grosvenor Street—Kitchen cart to be used for military and other purposes.—A com.
2081 J. Beard, Droylsden, Lancaster—Pumps
2082 S. Read, Glasgow, N.B.—Finishing fibrous and textile fabries
2083 J. S. Crosland, Manchester—Marine and stationary steam engines, boilers, and furnaces
2084 J. B. Couper, jun., Dunfermline, N.B.—Horse-shoes
2085 J. Bannehr, Great Queen Street, and H. Matthews, Gower Street—Drying, airing, and warming woven fabrics, bottles, and other articles
2086 J. Worth, Rochdale, and W. Turner, Tonaeliffe, near Rochdale—Cards for carding cotton, wool. &e.
2087 W. R. Lake, Sonthampton Buildings—Producing marqnetry and other divers colonred woodwork.—A com.
2088 W. R. Lake, Sonthampton Buildings—Machine for manufactnring horse-shoes.—A com.
2089 W. R. Lake, Sonthampton Buildings—Sofa-bedstead.—A com.
2090 W. R. Lake, Southampton Buildings—Machine for sawing, grooving, moulding, dovetailing, and otherwise working wood.—A com.

*12th July* 1869.

2091 Q. Dunlop and T. J. Martin, Ballymacarrett, county Down, and W. Orr, Ligoniel, county Antrim—Conplings and wheels for shafting and gearing
2092 J. Dewar, Kirkcaldy. N.B.—Treating certain snbstances for food and for manure
2093 C. A. Bates, George Street, Blackfriars Road—Apparatus to be applied to the months or openings of letter boxes to prevent letters being stolen therefrom
2094 E. Sutton, Regent Street—Speaking pipes
2095 L. Schalleidner, Paris—Engine to stamp the waxlights
2096 W. Bayliss, Wolverhampton—Iron vermin-proof rick stands
2097 J. Henderson, Leith—Snrface condensers and refrigerators
2098 C. D. Abel, Sonthampton Buildings—Apparatns for cleansing grain.—A com.
2099 C. Mertens, Barge Yard, Bucklersbury—Cartridge box.—A com.
2100 E. Pettitt, Manchester—Machinery for preparing and spinning cotton and other fibrous substances
2101 J. H. Player, Birmingham—Utilising the residual sulphate of lime produced in the manufacture of phosphorus
2102 W. R. Lake, Southampton Buildings—Manufacture of white lead.—A com.
2103 C. F. Dunderdale, New York, U.S.—Apparatus for generating hydrogen gas, and for carbureting hydrogeu gas or atmospheric air for illuminating and other purposes

*13th July* 1869.

2104 C. A. Count de Goddes de Liancourt, Queen's Road, Dalston—Life-belts
2105 C. Chapman, Salford—Application of pumps to artesian wells
2106 J. Piret, Paris—Slide-valves of steam-engines
2107 T. Restell, Birmingham—Breech-loading arms and cartridges, and a ponch or cartridge holder
2108 C. P. E. Roche, Paris—Conversion of cast-iron into a metal having a steelified nature
2109 W. P. Bain, Poplar—Sails for ships and vessels
2110 F. J. Smith and L. J. Abbott, East Derebam, Norfolk—Effervescing and aërated drinks and waters
2111 R. Craig, Dalkeith, N.B.—Apparatus for paper-making
2112 A. V. Newton, Chancery Lane—Mowing and reaping machines.—A com.
2113 R. Whitaker, Birmingham—Teetotums
2114 S. E. Crispe and J. West, High Street, Poplar—Apparatns for heating by means of steam
2115 J. Barnett, Minories—Breech-loading firearms.—A com.

*14th July* 1869.

2116 I. Baggs, High Holborn—Generation and treatment of ammonia
2117 C. Shether, Edmund Place, Aldersgate Street—Duplieate lock or fastening
2118 J. A. Horlick, Racine, Wiseonsin, U.S.—Pianoforte hammers.—A com.
2119 J. A. Horlick, Racine, Wisconsin, U.S.—Pianoforte bridges.—A com.
2120 T. Richards, Wincanton, Somerset—Stoves or fire-places
2121 R. Willcox, Kingstown, Dublin—Instruments for finding and for picking np submarine cables
2122 M. Jack, Cramond, Midlothian, N.B.—Agricultural implement
2123 J. W. Reid, Great Western Terrace, Bayswater—Beating engines employed in the manufaeture of paper
2124 J. Leetch, Broadley Terrace, Blandford Square—Self-adjusting spring stopper for closing the mouthpiece of speaking-tubes and bottles
2125 J. Leetch, Broadley Terrace, Blandford Square—Apparatus for effecting communication between the different parts of a railway train in motion

*15th July* 1869.

2126 V. Coine, Paris—A vertical æro-hydraulic engine with a double action
2127 J. Crowther, Blackburn—Seats of railway carriages
2128 J. Crowther, Blackburn—Working hoists
2129 J. Crowther, Blackburn—Velocipedes
2130 J. and J. Leeming, Bradford—Looms
2131 G. Lowry, Salford—Machinery for dressing and preparing flax for spinning
2132 W. W. H. Smith, Birmingham—Machinery to be used in the manufacture of upper leathers for boots and shoes
2133 B. J. B. Mills, Soutbampton Buildings—Annealing metals.—A com.
2134 A. Adámsz, Hoxton—Cigarettes
2135 C. de Bergue, Strand—Locomotives and other railway carriages—Partly a com.
2136 J. J. Cousins, Chapel Allerton, Leeds—Apparatus for indicating the points made and registering the number of games played at billiards and other games of skill
2137 J. T. A. Mallet, Paris—Charging atmospheric air with oxygeu
2138 C. D. Abel, Southampton Buildings—Coiled springs.—A com.
2139 J. T. Way, Russell Road—Manufacture of hydrochloric acid
2140 J. Bernard, Salisbury Street, Strand—Smelting
2141 J. H. Johnson, Lincoln's Inn Fields—Agricultural implements.—A com.
2142 J. Bernard, Salisbury Street, Strand—Obtaining and utilising heat in the operation of smelting

*16th July* 1869.

2143 J. E. Millar, Sowerby, York—Apparatus for raising the nap of woollen cloth
2144 W. Hosack, Montpelier, Jamaica—Evaporating liquids
2145 W. Hosack, Montpelier, Jamaica—Improved ship or vessel specially applicable for rapid transit on water
2146 J. Grint, Battersea—Circular-saw benches
2147 W. R. Lake, Southampton Buildings—Propelling machinery for canal boats and other vessels.—A com.
2148 R. P. Williams, Great George Street—Railway crossings
2149 J. W. Ormiston, Shott's Iron Works, Lanark, N.B.—Blast furnaces
2150 G. Yates, Heaton Norris, Lancaster, and J. R. Williams, Bowdon, Chester—Apparatus for opening and closing the lights of cucumber and other frames, so as to give air, and for actuating and regulating the ventilators in hothouses, &e.
2151 F. G. Fleury, Merrick Square, Southwark—Apparatus for drawing or raising and forcing liquids
2152 R. B. Evered, Drury Lane, and R. Hurst, High Holborn—Apparatus for raising, forcing, and regulating the flow of water
2153 A. Rollason, Bristol—Extracting ammonia, purifying gas liquor, and utilising the same

*17th July* 1869.

2154 B. Russ, Lime Street—Bicycles, velocipedes, and manumotive carriages
2155 P. Murray, Levis, Quebec, Canada—Rocking fire-bars for steam-boiler and other furnaces
2156 W. Pidding, Walcot Square, Lambeth—The production or manufacture of cnt piled mosaic, mosaic, textile, and tesselated fabrics
2157 H. Mège, Paris—The preparation and production of certain animal fatty bodies
2158 E. F. Jones, Middlesborough-on-Tees—Machinery for making nails, spikes, and like articles.—A com.
2159 H. E. Newton, Chancery Lane—Breech-loading firearms.—A com.
2160 H. E. Newton, Chancery Laue—Electro-magnetic engines.—A com.
2161 A. Simpson, Chiswell Street—Apparatus for cleaning knives
2162 M. Eyth, Leeds—Carrying the steering or other road wheels of implements, traction engines, or other machines adapted for moving over common roads or fields
2163 D. N. Defries, Euston Road—Gas-meters
2164 A. Aneion, Liège, Belgium—Breech-loading firearms
2165 C. Hook, Bridgewater, Somerset—Velocipedes
2166 J. H. Johnson, Lincoln's Inn Fields—Blasting.—A com.
2167 C. J. Harcourt, Lozells, Aston Manor, near Birmingham—Axle-pulleys for suspending window-sashes
2168 J. Bernstein, Bethnal Green—Umbrella, parasol, and walking-stick handles

*19th July* 1869.

2169 W. Furness, New Street, Borough Road—Cutting files and rasps
2170 J. H. Johnson, Lincoln's Inn Fields—Sewing-machines.—A com.
2171 J. Imray and G. G. M. Hardingham, Great George Street—Sewing-machines
2172 B. Lookcr, Kingston-on-Thames—Earthenware box or pan for growing, raising, or forcing seeds, plants, or cuttings

2173 W. Leftwich, Holloway—Velocipedes
2174 W. Macgeorge, Castle Court, Birchin Lane, and A. Rigg, jun., Chester—Mechanism for starting and working steam-engines
2175 R. Neale, Brooklyn, New York, U.S.—An improvement in transfer engraving
2176 W. E. Gedge, Wellington Street, Strand—Generating steam.—A com.
2177 A. M. Clark, Chancery Lane—Cables for the transmission of electric currents.—A com.
2178 R. Schloesser and J. Irving, Manchester—Converting wood shavings, flax, tow, hemp, jute, esparto-grass, straw, hay, and other materials of a fibrous nature into paper pulp
2179 V. E. Mauger, New York, U.S.—Blotter or ink absorber.—A com.
2180 B. Hunt, Serle Street, Lincoln's Inn—Looms.—A com.
2181 R. Duerre, Chelsea—Lever manumotive apparatus
2182 J. B. Pondu, Braine-le-Comte, Belgium—Blowing glass
2183 T. Thomas, Bridge End, Cardigan—Mills for grinding and bruising or crushing corn or other grain
2184 W. Williams, F.R.S.E., M.R.C.V.S.—An elastic horse-boot

20*th July* 1869.

2185 R. G. Fisher, Great George Street—Rafters or bearers for roofs and floors
2186 T. Holt, Rochdale—Apparatus for supplying and distributing disinfectants to closets
2187 R. Olivier, Paris—Velocipedes
2188 F. Fleming, Halifax—Driving-straps or belts
2189 R. Saunders, Croydon—Buffing railway carriages
2190 J. Rehse, Memphis, Tennessee—Cure of stammering
2191 J. E. Holmes, Buckingham Street, Strand—Attaching or securing the free ends of wire and other ropes.—A com.
2192 W. Rose, Halesowen, Worcester—Bearings for cast-iron rolls and shafts
2193 D. Trevor, Birmingham—Apparatus for facilitating the production of photographic pictures
2194 A. Stansfeld, Cornhill Chambers—Apparatus for propelling on land and in water
2195 S. Hall, Swansea, Glamorgan—Apparatus for moulding artificial fuel
2196 J. H. Johnson, Lincoln's Inn Fields—Dyeing and printing.—A com.
2197 H. Higgins and T. S. Whitworth, Salford—Improvements in apparatus for preparing, spinning, and doubling cotton &c.
2198 G. Finnegan, Dublin—Machinery for sawing wood and stone
2199 J. Ellison, Lisburn, Antrim, Ireland—Manufacture of rope, cord, and twine
2200 H. B. Clark, Buntingford, Herts—Horse-rakes

21*st July* 1869.

2201 J. W. Larmuth, Pendleton, Lancaster—Connecting together the ends of the hoops or bands employed in the packing of cotton &c.
2202 J. Duke, Dover—Construction of ships
2203 J. Ogden, Manchester—Combined tap and filter
2204 W. R. Lake, Southampton Buildings—Marline spikes.—A com.
2205 W. Brookes, Chancery Lane—Spinning carded wool on small cops ready for weaving.—A com.
2206 G. Follett, Peckham—Waterproof facing for brick buildings
2207 G. H. Ellis, Gracechurch Street—Rotary engines
2208 A. H. Brandon, Paris—Springs applicable to railroad or street cars.—A com.
2209 G. Allibon, Northfleet, Kent, and A. Manbré, Baker Street—Steam boilers
2210 J. Boyd, Glasgow, N.B.—Machinery for winding yarn or thread
2211 A. C. Kirk, Glasgow, N.B.—Apparatus for abstracting heat
2212 J. H. Johnson, Lincoln's Inn Fields—Obtaining extract from hops.—A com.
2213 H. E. Newton, Chancery Lane—Brad-driver—A com.
2214 M. Tildesley, Willenhall, Stafford—Ties, clips, or fastenings for connecting the bands employed in securing bales of cotton, wool &c.
2215 A. M. Clark, Chancery Lane—Carding-engines.—A com.
2216 F. M. Mole, Birmingham—Manufacture of matchets and cutlases
2217 H. Knight, Ryde, Isle of Wight—Apparatus for clipping horses and other animals.
2218 G. T. Abbey, Chicago, Illinois, U.S.—Breech-loading firearms

22*nd July* 1869.

2219 J. Dawson, Leeds, and T. C. Fawcett, Leeds—Raising gigs
2220 W. Currie, Edinburgh—Manufacturing and fastening the soles and heels of boots and shoes
2221 W. H. Gosling, Calthorpe Street—Sewing-machines
2222 J. Rowley, Wells Street, Camberwell—Manufacture of certain coal-tar products
2223 W. H. Stone, Dulwich Hill—Apparatus for taking, counting, and recording votes by ballot
2224 J. Green, Lisburn, Down, Ireland—Improvements in the manufacture of ropes, cords, and twines &c.
2225 W. Warren, Jersey—Ships' anchors
2226 W. Bull, Waltham Cross—Velocipedes
2227 W. A. Gilbee, South Street, Finsbury—Preserving the aromatic principle of hops.—A com.
2228 W. Dennis, Aldermanbury—Letter-boxes, letter-pillars &c.
2229 W. K. Stock, Darlington—Looms
2230 J. Walsh, Manchester—Hoods for invalid perambulator and other vehicles
2231 J. G. Wilson, —Velocipedes
2232 R. Boyd, Strand—Boilers and furnaces for producing superheated steam.—A com.
2233 T. Barnes, Whitehaven, Cumberland—Treatment of coal for the removal of the sulphur compounds contained therein
2234 J. Hayward, Ecklaud Bridge Works, near Penistone, York—Manufacture of combs
2235 W. R. Lake, Southampton Buildings—Telegraph-wire insulators.—A com.
2236 W. Laing, Carron Vale, Stirling, N.B.—Washing-machines

23*rd July* 1869.

2237 W. Morris, Blackheath—Points or switches for tramways.—A com.
2238 W. Lincolne and E. Chafer, Glasgow, N.B.—Manufacture of artificial marble or stone
2239 E. Stevens, Margate—Cooking
2240 J. H. Johnson, Lincoln's Inn Fields—Joints of pipes and tubes.—A com.
2241 J. H. Johnson, Lincoln's Inn Fields—Purifying alcohol and paraffine.—A com.
2242 G. T. Bousfield, Brixton—Harness motion for power-looms.—A com.
2243 S. Bishop, Great St. Helen's, Lancashire—Lamps for burning paraffine oil
2244 S. Cotton, Belfast—Machinery for hackling flax &c.
2245 W. Mort, Fenchurch Street—Refrigerating and freezing apparatus.—A com.

24*th July* 1869.

2246 I. Frankenburg and S. Phillips, Manchester—Manufacture of hats and hat bodies
2247 H. Greaves, Abingdon Street—Construction of the permanent way of railways and tramways, and the carriages and engines used thereon
2248 W. Dredge and A. Stein, Buckingham Street, Adelphi—Machinery for propelling carriages
2249 R. Pictet, Paris—Improvements in the building of pumps in general, which permit their working without pistons and oil
2250 J. Dewe, Toronto, York, Ontario—Improvements in mail-bags, and in apparatus for fastening such bags, boxes, and other receptacles, where the security of a seal is required
2251 C. L. Cleasid, Pall Mall East—Collars and false collars for horses and all other beasts of burthen.—A com.
2252 G. N. Blanc, Glasgow, N.B.—Machine for mortising timber
2253 R. G. Lowndes and J. Reid, Auldhousefield Mill, Renfrew, N.B.—Manufacture of textile fabrics
2254 T. Auchincloss, Glasgow, N.B.—Apparatus for heating feed-water, and for feeding the same to steam-boilers
2255 C. Y. Michie and G. W. Murray, Banffshire, N.B.—Pillars or standards for straining and supporting wires for fences, &c.
2256 W. Tongue, Brixton—Generating steam with economy in fuel
2257 D. H. Brandon, Paris—Improvements in metallic cartridges, their primers, and in the methods of manufacturing the same.—A com.

26*th July* 1869.

2258 W. Crossley and J. W. Swithenbank, Bradford—Shuttles
2259 T. Winter, Wiveliscombe, Somerset—Machinery for combing reeds
2260 J. Holding and J. Eccles, Manchester—Looms
2261 J. G. Rollins, Upper Thames Street—Combined reaping and mowing machines.—A com.
2262 J. Hyde, West Bromwich, and J. Hyde, Warwick—Safety-lamp for preventing explosions in collieries
2263 E. Attenborough, Nottingham—Manufacture of looped or knitted fabrics
2264 B. Hunt, Serle Street—Valves.—A com.
2265 C. Cochrane, Upper Gornal, Stafford—Smelting
2266 W. W. Roberts, Portland Road, Notting Hill—Improvements in the construction of furniture and fittings, also in cornices, skirtings, walls, and ceilings of buildings generally, for the prevention of bugs
2267 E. Ginder, Aston-juxta-Birmingham—Breech-loading firearms
2268 W. E. Tilley, Kirby Street, Hatton Garden—Coating or electro-plating iron, copper, brass, lead, and other metals with tin
2269 J. H. Johnson, Lincoln's Inn Fields—Treatment of night-soil and other waste products, and the manufacture of manure therefrom.—A com.
2270 R. Shaw, Higher Walton, near Preston, and R. Lakin, Manchester—Carding engines

27*th July* 1869.

2271 J. Miller, Victoria Park—The mariner's compass
2272 C. Henderson, Gracechurch Street—Girders used in the construction of arches or otherwise combined with iron, timber, stone, or brickwork
2273 M. J. Frisbie, New York, U.S.—Carriage axles
2274 J. Winship, York—Preparation and application of medicaments for internal and external use
2275 I. Barker, Stourbridge—Manufacture of coffered spades and shovels
2276 T. Parsons, Massachusetts, U.S.—Apparatus, or engine, to be used either in measuring water discharged from a conduit or for various other useful purposes.—A com.
2277 D. T. Bostel, Brighton—Dry-earth closets
2278 J. Windle, Sheffield—Rolling hoops or tyres of iron or steel
2279 W. R. Lake, Southampton Buildings—Apparatus for shearing or clipping animals and skins.—A com.
2280 A. M. Clark, Chancery Lane—Manufacture and refining of sugar.—A com.

28*th July* 1869.

2281 W. A. Lyttle, the Grove, Hammersmith—Electro-telegraphic apparatus
2282 D. A. Fyfe, Bolton—Manufacture of paper
2283 H. Gillan and G. Crawford, Glasgow—Apparatus for spinning or twisting and rolling tobacco
2284 F. Crossley, Prince's Terrace, Bonner Road, Victoria Park—Preventing metals from rusting or corroding
2285 A. V. Newton, Chancery Lane—Apparatus for facilitating the grinding of the knives of harvesting machines.—A com.
2286 A. Burdess, Coventry—Winding up watches and other timepieces, and moving the hands thereof

29*th July* 1869.

2287 H. A. Bonneville, Sackville Street, Piccadilly—Looms.—A com.
2288 H. A. Bonneville, Sackville Street, Piccadilly—Improvements in weaving looms and in their shuttle-boxes.—A com.
2289 H. S. Heyman, Manchester—A process by which the waste of flax and hemp is converted into substitutes for cotton, wool, and flax.—A com.
2290 A. Smith and D. Cunningham, Stonehouse, Lanark, N.B.—Treating and refining crude mineral, petroleum, and other hydrocarbon oils
2291 J. Tate, Portadown, Armagh, Ireland—Machinery for scutching, breaking, and preparing flax, hemp, jute, and other fibrous substances, and for thrashing corn or grain
2292 D. R. Kilpatrick, Glasgow, N.B.—Application of springs to chairs, couches, or other seats and beds.—A com.
2293 W. E. Gedge, Wellington Street, Strand—Apparatus for lubricating parts of locomotive and other engines.—A com.
2294 T. F. Taylor, Philadelphia, U.S.—Machinery for manufacturing metal tubes

30*th July* 1869.

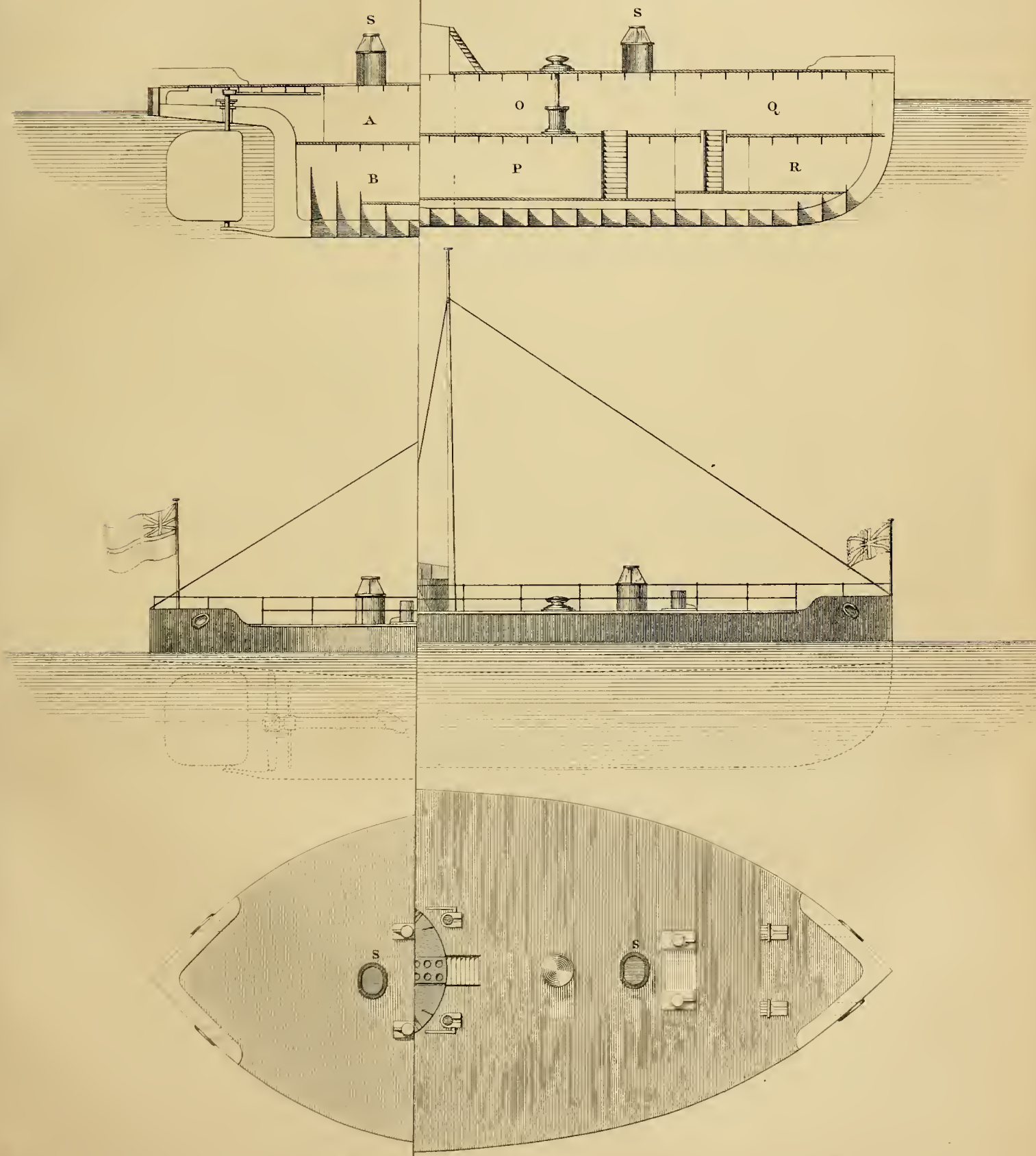
2295 J. S. Kipping, Manchester—Fixing colours on textile fabrics
2296 T. W. Lockyer, Monkwell Street—Ladies' parmiers or bustles
2297 W. R. Lake, Southampton Buildings—Block calendars and other similar articles.—A com.

31*st July* 1869.

2298 G. Allibon, Northfleet—Steam-engines
2299 A. Patène, F. Bardoux, and G. Jurie, Paris—Reproducing on wood all engravings through aqua-fortis
2300 J. B. B. Pinchon, Amiens, France—Apparatus for condensing steam
2301 C. and T. Watts, St. Mary's Terrace, Paddington Green—Indicating stations to passengers by rail or tramways
2302 D. Stewart, Glasgow, N.B.—Apparatus for concreting sugar-cane juice.—A com.
2303 F. Jackson, Wigan—Lubricators for steam-engines
2304 J. M. Clements, Birmingham—Sewing-machines
2305 C. N. Eyland, Walsall—Buckles for articles of dress
2306 B. Goddard and W. Fiuley, Stockport—Apparatus for mixing substances for pills, ointment &c.
2307 J. C. Mills and J. Sandiford, Stand Lane, near Radcliffe, Lancaster—Pins, pirns, or bobbins for shuttles &c.
2308 H. S. Edwards, South Shields—Gearing for auxiliary screw engines
2309 T. Ramsay, Gateshead—Apparatus for the manufacture of gas
2310 J. Beckett, Llandudno, Caernarvon—Self-acting breaks for railway carriages
2311 W. R. Lake, Southampton Buildings—Direct-acting steam-engines.—A com.

2*nd August* 1869.

2312 S. M. Smith, Bradford—Dyeing certain textile fabrics
2313 P. R. Hodge, Adam Street, Adelphi—Manufacture of luminous and heating gas from hydrocarbonaceous fluids
2314 J. Sharrocks, Rochdale—Locomotive engines
2315 L. W. Wright, Brooklyn, New York, U.S.—Paddle-wheels
2316 W. Hosack, Montpelier, Jamaica—Mills for extracting saccharine juice from sugar-cane
2317 F. A. Yeo and H. Hanna, Swansea—Machinery for the manufacture of artificial fuel
2318 M. Henry, Fleet Street—Apparatus for ventilating mines, drains and other places, and extracting noxious gases, smoke, and vapours therefrom.—A com.




Patent Offices 47, Lincolns Inn Fields London & 166 Buchanan St Glasgow.

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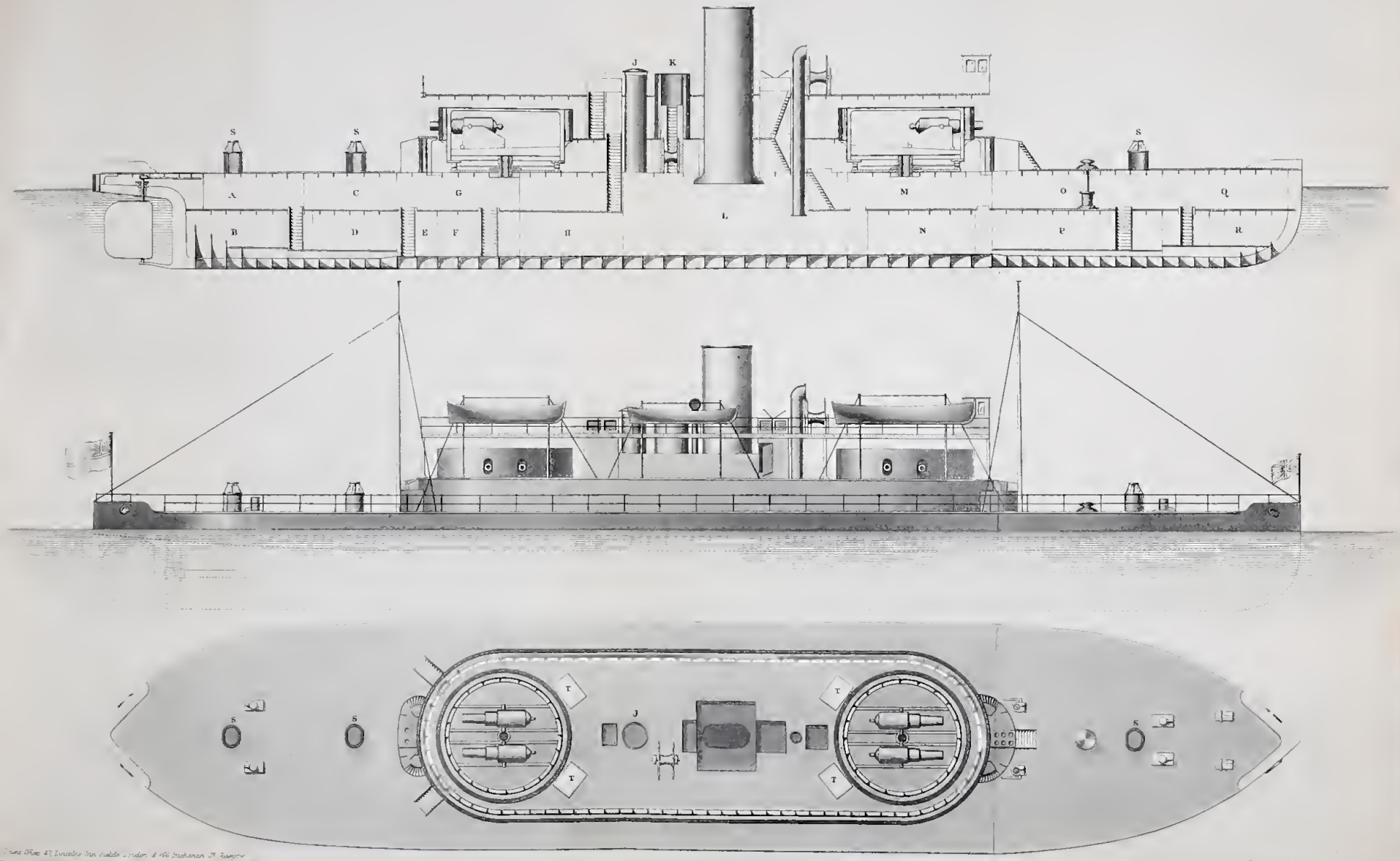
# THE BREASTWORK MONITOR "CERBERUS."

SCALE ⅛ INCH. = 1 FOOT.






Spottiswoode & Co London & Westminster

## ON SOME POINTS OF PRACTICE IN IRON-FOUNDING.

### No. XXXIX.

*Air-Furnaces—(continued).*

NOTWITHSTANDING the commendations lavished by the older race of founders upon the reverberatory as compared with the cupola, which have to our day descended as a sort of vague tradition, there can be little doubt but that a century ago or so, when iron-founding began to assume large proportions, the choice was dictated rather by necessity than by real preference for the air-furnace. The latter had long been known amongst the great bronze statuaries and bell-founders, and so its powers were recognised; and its capability of fuzing such delicate and oxidizable alloys gave assurance that the quality of the cast-iron need not suffer that deterioration which the use of impure fuel and very poor blast often produced in the small early cupolas, or *Wilkinsons*, as they are sometimes called to the present day in France. But the cupola had not reached any large size, nor were the blowing engines of that day competent to larger ones. Indeed, the very largest blowing engines for the blast furnaces of Smeaton's time, for smelting the ores of iron, were not greater in air-delivery power than is required for one of the enormous cupolas now in use—cupolas in cavity quite as large as many of the earlier "high furnaces," or smelting blast furnaces. The founder, then, who needed to melt five or six tons or more of pig-iron, after the first or smelting fuzion, found the reverberatory his most practicable instrument, and no doubt made his choice chiefly on that ground.

At the present day, with the mechanical means of procuring ample blast—with these admitting of the construction of cupolas of any magnitude—with highly refractory brick for lining easily had, and with coke fuel as pure and dense as perhaps is practically possible—the importance and value of air-furnaces have unquestionably relatively much receded. There is nothing that can be done with the air-furnace, with perhaps two exceptions, that cannot by skilful management be effected also by the cupola, and at much less expenditure in time, capital, fuel, and labour. These exceptions are—first, that if we desire to melt a given variety of cast-iron as absolutely as possible free from *any* change in its constitution, chemical or molecular (other than such changes as in crystalline arrangement are inevitable as regards the last by mere change of mass and form after casting and cooling), we can do so generally with *rather* greater certainty by the air than by the cupola furnace; i.e. we can more certainly tell at every moment that we are commanding a neutral flame, neither oxidant nor deoxidant, than with the cupola. But the larger the scale of operation, the larger both of the two furnaces, the less is this difference between them.

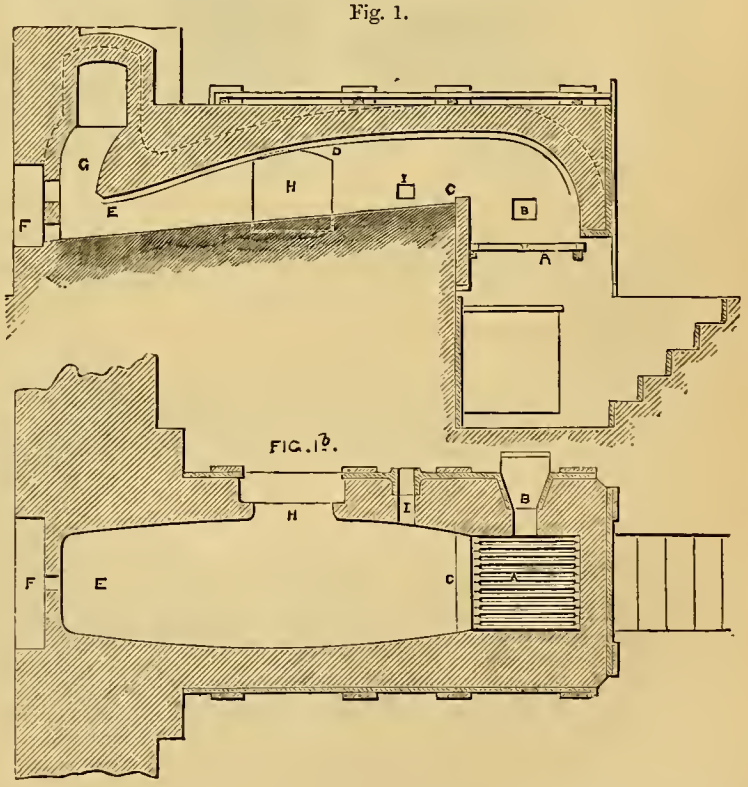
Secondly, if we are compelled to employ pig-iron, which, having been smelted either by imperfect methods or from certain ores, still contains sulphur (rarely arsenic) in large proportion, we can free it from a great deal of this by merely prolonging the exposure of the bath of metal, after fuzion in the air furnace, under a slightly oxidating flame. This is occasionally, but only rarely, important; for pig-iron very rich in sulphur, as we have before now stated in these papers, runs so thick and "liver-like," as the moulders say, that sound castings are impossible with it. On a large scale of operation this disulphuration may be effected partly in the passing through the cupola (with ample blast and reduced supply of fuel), and partly by letting the fuzed metal stand as long as possible in the crane-ladle before its passing into the moulds, and taking care constantly to keep the surface skimmed clean and freely exposed to the air. But the disulphuration in this way, owing to want of time, is necessarily imperfect, and our own pretty obvious advice would be, Don't use any such pig-iron at all, or at any price, while plenty of good pig is to be had. Its apparent low price when offered in the market will be found far more than neutralised by the wasteful use of the air-furnace, and by the multiplication of bad castings. The use of nitrate of soda may occur to some, as a rapid method for disulphurating such pig-iron by its addition in the ladle; but as the oxygen of that salt must remove carbon in large amount also, that process would often injure the cast-iron for the founder's use, and always prove too expensive. Sulphury pig-iron, we may remark, when it occurs in Great Britain, usually arises from smelting exhausted pyrites of the alkali works with other ores; in Sweden it comes from pyritose ores directly.

The conditions under which the air-furnace is indicated for use, according to Mons. Guettier, are—

1. Where we have no means of obtaining adequate blast for a cupola.
2. Where we need to melt down masses so huge that they cannot be managed in the cupola.
3. When we want (by deoxidation) to bring a given pig-iron to its highest point of tensile resistance; as for iron-gun founding.
4. When, through the accidental variations of trade, orders for unusually heavy castings tax the foundry beyond the point to which the establishment, as regards blast for cupolas, can reach; then in aid of the cupolas.
5. When we have to establish a foundry under circumstances where a blast is impossible, as in some wild colony, or in a besieged place, or the like.

Guettier, however, with the skill of a really practical man, very much qualifies even these conditions, indicating at least his notion that, except in the last case, we can always do what we need without the air-furnace, which, he says, can never prove economical either in metal or fuel, except where all the operations are constant day by day, and on a very large scale indeed. On the other hand, we may certainly affirm that for small or medium-sized foundries, or wherever good bituminous coal fuel is dear, there the air-furnace should never be thought of.

Fig. 1.




For our own part, we look upon the reverberatory furnace, viewed as part of the apparatus of the iron-founder, as really out of date under existing circumstances, in Great Britain at least; but we cannot avoid seeing that, by certain modifications, its performance may be vastly improved, and that an (as yet) almost untrodden field of improvement remains open to it in the *effective*

application of the gas-fuel system. This, which has been successful in so many other applications of reverberatory furnaces, has not hitherto been such as it might be in the application to the fuzion of large masses of pig-iron. In the trials made, as, for example, at the Mersey Steel Company's works at Liverpool, the comparative failure appears to have been traceable to two main causes—the charging the furnace beforehand with an enormous bulk of pig-iron (five tons), piled up in one cold mass, which cools down the gases, at first perhaps actually below their igniting point; and the want of a sufficiently cutting draught, so as to cause the gas-flame really to *impinge* upon the iron at one special focus, which is to be that of fuzion.

No doubt, with the regenerative system, it is all only a question of time, for however gently the gases may glide through the furnace, they cannot fail at last to reach such a temperature as shall bring down the iron; but this may mean a serious waste of time and money, and great destruction of the furnace itself. In a word, *quick melting is the soul of good melting* for the iron-founder; and we may obtain this with the gas-furnace, probably in a highly efficient manner, by driving by blast the mixed air and coal gases, like huge blow-pipe jets, in the right direction and into the right region of the furnace, when we really convert the reverberatory into a huge gas blow-pipe; or, if solid fuel is to be used, then by the employment of blast at the right time, in aid of the chimney draught, as done by M. Sudré for cast-steel melting, and by highly heating that blast, as was not done by him.

Fig. 2.

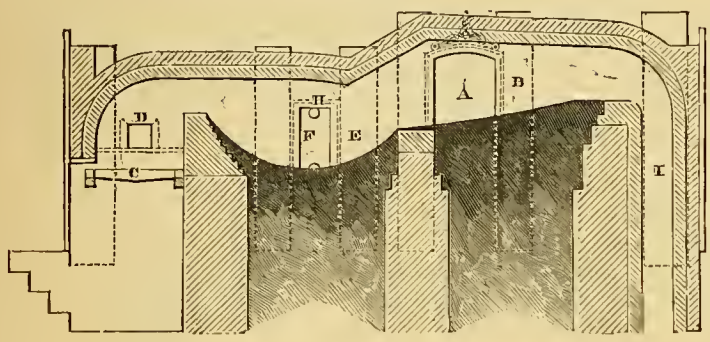
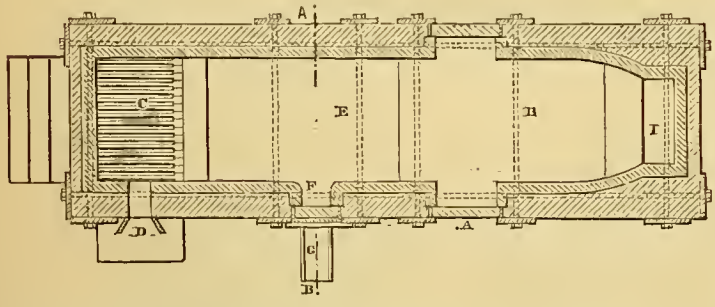


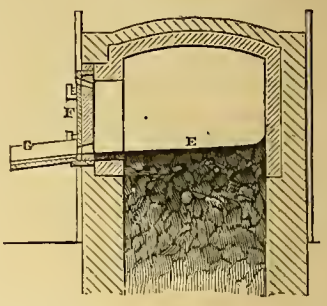

Fig. 3.




Upon the choice of fuel, with any ordinary reverberatory, very much of its good or bad working depends; and the furnace that will work well with one sort of fuel will not do so if charged with another. Dry wood is never a powerful fuel, for it contains only about one-half its weight of carbon; the other half consisting of hydrogen and oxygen in nearly the proportions to form water by combustion, and which elements therefore go for nothing as respects production of heat. Yet it does admirably well as fuel for the porcelain-baking furnaces of Sèvres-Meissen &c., which, though differing in form, are really of the nature of reverberatories; but this arises from several circumstances, which have no analogy whatever with iron-melting, and it is in porcelain-baking almost a necessity, because mineral fuels discolour the "biscuit" and change the enamel colours of the painting. The porcelain furnace needs to be slowly "brought up" to its highest temperature, and the mass of the porcelain to be heated is very small, though its bulk is great. With iron we want precisely opposite conditions. Wood gives a very long flame, and if it have to be employed, needs a furnace with a long flame-bed and low arch.

Among the varieties of vegetable fuel, turf and brown coal are, in fact, excluded, except as gas-producing fuels; the volume required (working with solid fuel) being so great, that the furnace is cooled by the frequent opening to feed &c., and the cost of labour in firing very great, and the service difficult. And amongst the mineral fuels, although the hardest—anthracite or coke—*may*, no doubt, by suitable means, and more especially by cutting draught, be rendered possible, these are the very worst for the air-furnace we can have. Fine, free, long-flaming bituminous coal, tolerably hard, not caking, or but slightly caking and not falling into small fragments when suddenly heated, is the fuel which presents the very best properties. Caking coal is not absolutely unusable, especially in very large furnaces; but it is always troublesome and objectionable, needing nearly constant breaking up with the poker to free the air-currents, and never maintaining that *uniform* stopping of ignited fuel all over the bars that is the condition of least loss of time and heat.

Fig. 4.




Again, coal (such as some of the splent coals of Scotland and of our midland coal-basin) which are very rich in fuzible ashes, are objectionable, from the large supply of "clinker" choking the bars, and obstructing the draught; and the removal of this by the bar causing the admission of streams of cold air.

Self-feeding apparatus, something of the nature of many of those applied to smoke-consuming steam-boilers, have been applied to the fireplaces of some reverberatories employed in chemical manufactures; but it may be doubted if such are applicable to iron-founding air-furnaces as so far constructed. Most air-furnaces are provided with fire-tile drops, or doors, for closing the firing aperture, and this is kept open whilst throwing on fresh coal, but for the briefest possible time. When we remember, however, that the velocity of draught on these furnaces often exceeds 10 or 15 feet per second, we readily imagine the great cooling produced by the admission of cold air above the fuel even for such brief intervals. Accordingly, many air-furnaces are provided with dead-plates outside the firing aperture, or with hoppers around it, either being kept filled or heaped with coal, and so spread as effectually and always to close the aperture; and as the fuel is needed in the fire, it is pushed forward or downward by bar and slice. This, according to our experience, works well, but it needs a spy-hole and a careful fireman to watch the state of the interior, lest at any moment the bars get bare, or partially so. A sort of turning-box or reversing hopper has also been employed, which, after being filled with coal, on turning over pitches its contents on to the top of the fire, without admission of air; but this, which we once tried, does not answer well. The coal is thrown into one heap, requires spreading, which involves some admission of air, and at the first instant generally evolves a dense cloud of black smoke, the indicator of waste and of bad firing everywhere.

Nothing is easier than to calculate out formulæ by which the proportions of air-furnaces may be supposed to be fixed, starting from the data that a given weight of cast-iron is to be melted in a given time. Theory in reality here is of but little real use, except in giving certain leading indications; for the contingent conditions brought into play in practice are too delicate and too numerous to admit of its application—we must trust mainly to experience.

At the outset we may affirm this, that the draught never can be too strong; no expense or pains, therefore, should be spared to produce a stalk giving the best possible one. Sixty feet to eighty feet in height is not too much; square sections appear, on the whole, best, and the transverse section of the shaft will with advantage be at least equal in area to the entire grate-surface of all

the air-furnaces that are to draw into it. Those not in use at any time should be built off from the stalk; dampers between such furnaces and the stalk are scarcely possible. The air-draught supply to the grate and ash-pit are best (indeed, almost necessarily in large furnaces) below the foundry floor level. Ample air-way and easy inspection below the fire-bars should be provided by a short flight of stone steps. Long horizontal flues to connect between furnace and stalk are not desirable; they retard the draught, and always come to leak in the joints, and draw in air.

The theoretic minimum amount of fuel that can melt 1 lb. of cast-iron, as stated in former papers of this series, is a matter of little real importance here. Were we able to utilize *all* the heat of coal, one pound weight of it would more than melt from 30 to 35 lbs. of cast-iron. In actual practice with the reverberatory, as we shall see, one pound of coal is consumed in melting about 2 lbs. of iron; in other words, the instrument is so imperfect, that we waste about $\frac{15}{16}$ of the fuel consumed, or quite $\frac{3}{4}$, if we allow for that necessarily consumed for the production of draught.

The results of considerable experience have proved that in ordinary air-furnaces, when well worked with good coal fuel, from 84 to 112 lbs. of coal are a minimum sufficient to bring down each ton of pig-iron, after the furnace has got thoroughly heated, and the first charges have been drawn. This proportion, after a time, increases as the furnace gets coated with more and more scoria, and the grate &c. in worse order. But, taking the whole operation of fuzion, from first lighting the furnace with such as will hold from 5 to 10 tons, to tapping out, the general consumption of coal is from 8 to 10 cwt. to the ton of iron melted. Many furnaces we have seen professedly worked with less; and, with first-rate draught and skilful management, this is, no doubt, possible; but the delicacy of management, upon which economy in these furnaces depends, is such, that, in almost all cases, they are wasteful to the extent above stated. If we take 900 lbs. of coal as the consumption to the 2,240 lbs. of iron melted, and that the entire charge is to be brought down in a given time, say in four hours, we obtain at once the volume of air that must be passed through the fire-grate per second; remembering that we must pass much more air (occasionally) than is merely necessary for complete combustion, viz. 12 lbs. of air per pound of coal. We may therefore provide for one-half more than that, or 18 lbs. of air per pound of coal burnt, or about 230 cubic feet per pound of coal burnt. Experience proves that we cannot burn off perfectly more than about 25 to 30 lbs. of coal per hour, by draught, upon each square foot of grate surface; so that, if w = the total weight of coal to be burnt in each hour, we have $\frac{w}{2}$ or $\frac{w}{30}$ = area of grate for fuel. But we must enlarge that by the air-spaces between the bars; such that, at the assumed velocity of draught, the required volume of, say, 230 cubic feet of air shall pass; and, making some allowance for contraction and clinkering, these two elements give some rough guide to the area of the grate-bars, and to the capacity of the fireplace, which should be such that at least 12 inches in depth of fuel shall be at once in combustion, a depth which, with proper coal, may be much exceeded. As to the fire-bars, their distance apart depends, in some degree, upon the nature of the coal. If that does not break up rapidly on being heated, or, in consuming, divide into small pieces, the air-spaces can scarcely be too wide; every distance apart, from $\frac{3}{4}$ of an inch to $1\frac{1}{2}$, is practised. The bars are often made of hard white cast-iron (which melts with more difficulty than gray iron), and, in the common form of the bars of boiler furnaces, in short lengths, with a mid cross range of sleeper for the abutting ends; but this is a bad form; wrought-iron bars are to be preferred. These, in older times, were square bars cut off to the right length, and bent at right angles at the ends to cause them to preserve their distances. We have also seen square bars used simply cut off and laid into triangular notched cast-iron sleepers, the one diagonal of the square section of each bar being vertical; and these, though they spread more horizontally, and so need a longer total grate for equal air-spaces, work well. Wrought-iron flat bars cut off and dropped into notched wrought-iron sleepers, which can be made cold by the punching-press, are, we think, best of all; they should not exceed $\frac{7}{8}$ of an inch in thickness, and must be deep enough not to bend when at their fullest heat under the weight of fuel. Whatever be the area of air-way through the grate, the clear area of vertical section above the bridge must be a good deal less, for it is partly upon this contraction that the concentration of the heat on the surface of the sole or sumph, just beyond the bridge, depends. Here theory really affords us no reliable guide, experience is all we have: this appears to indicate that the area of the grate and air-way is best from 3 to $3\frac{1}{2}$ times the vertical cross section above the bridge. The height of the bridge above the grate bars in part depends, as already observed, on the needful capacity for fuel of the fire-

Fig. 5.

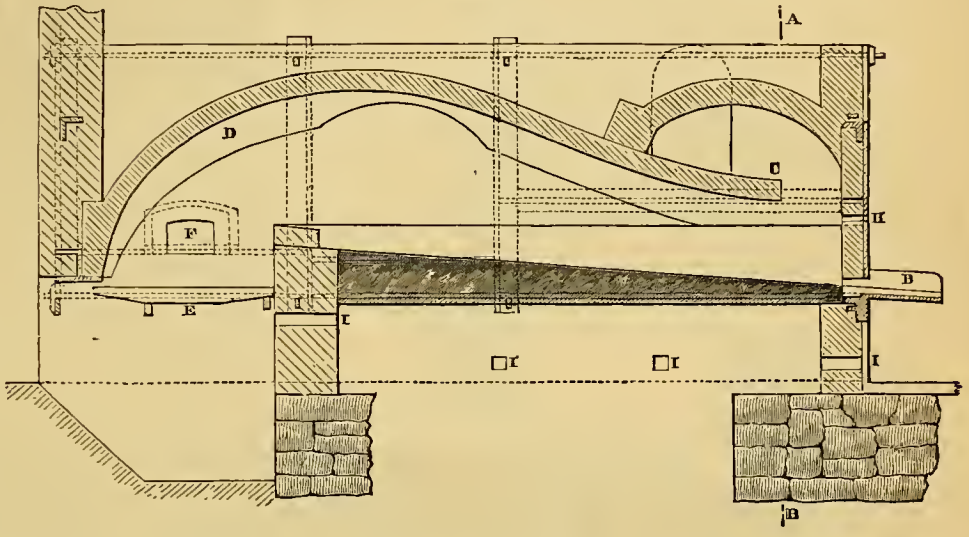
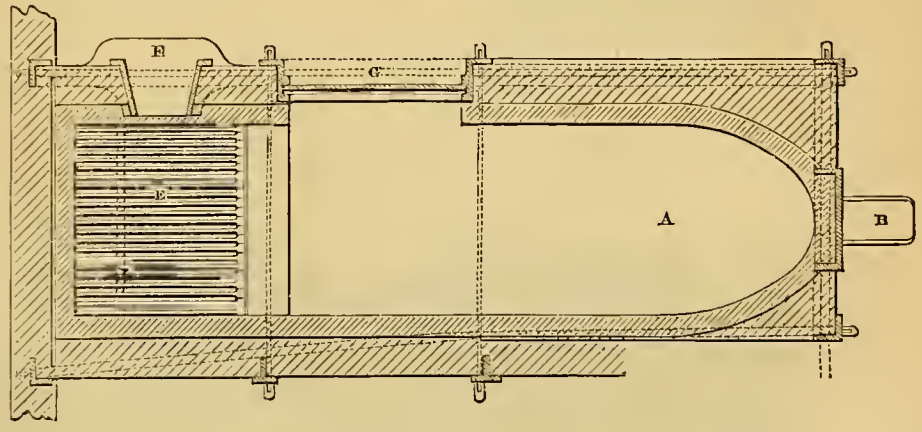
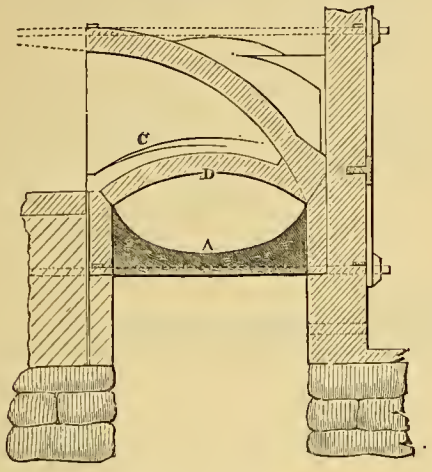



Fig. 6.



place; but it must be rather higher for fine long flaming coal than for that which is drier, or with shorter flame. The sole or sumph of the furnace is almost always, for iron melting, more or less rectangular. The width is determined in a great degree by the dimension of the fire-grate alongside the bridge. But the length must be duly proportioned to this, and experience proves that, with fine long flaming coal, this is best in the proportion of from twice to three times the width across the bridge. With drier short flaming coal twice, or even once and three-quarters, that width is enough.

Fig. 7.




As to the forms of the arch and of the sole or sumph, they may be greatly varied; yet, bearing in mind the general principle which we stated in the last paper, No. XXXVIII., as to the effect to be aimed at by the former in relation to the latter, it is obvious that, given all the preceding data, then these parts decide their own forms within tolerably clear limits. Some founders attach great importance to the position within the entire length of the furnace where the sumph is to be deepost, and hence where the mass of fuzed cast-iron is to accumulate. Our own view is that this matters but little, provided the furnace generally works well. If it is very slow in melting, there can be no doubt that the inclined bed, with the melted iron as far as possible from the bridge, has the advantage in least injury to the iron; but with a good furnace we should prefer the sumph as deep and as close up to the bridge as possible.

As for the connection, then, at the escape flue from the furnace with the chimney, it is best adjustable by fire-brick &c., but should always be in area larger than the vertical cross section above the bridge. In fact, the faster and the less resistance with which the products of combustion are swept away and got into the chimney-stalk after they have done their work on the sole of the furnace, the better; and all that has to be guarded against here is, that this part of the furnace shall not have so free a draught in relation to that over the bridge as to sweep the flame too far on upon the sole, or draw it actually into the chimney, so as to blaze away fuel therein without its doing any work except in destroying the stalk.

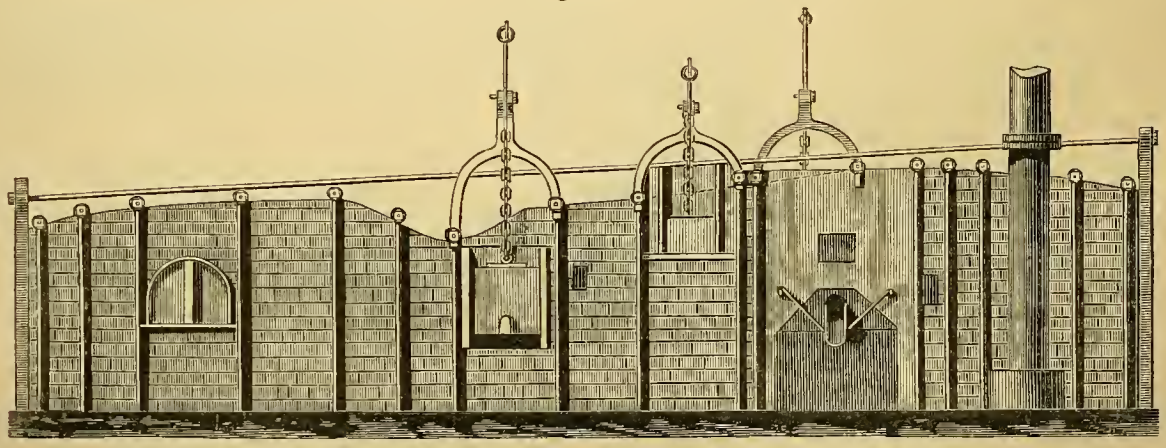
As to the minuter details of air-furnace construction—such as internal chimney linings, iron plate or skeleton framing for the body of the furnace, bricks and fire-blocks, arch bonding, tyes, fire-clay door mounting and balancing, &c. &c.—we must leave these to be gathered from working drawings of furnaces, as leading to too great length in papers of the character of these present. Reverberatory furnaces, both in construction and in working, have been the result, slowly evolved, of innumerable trials, errors, and tentative improvements, the inevitable consequence of the small way that *à priori* or theoretic considerations can here guide us. Hence every wise iron-founder who may desire to construct such furnaces will do best, although having mastered the general principles as we have sketched them, to adopt for his model the working drawing of some well-established furnace which has been proved to work well elsewhere. Such a type once obtained may, within certain limits and under intelligent guidance, be enlarged or reduced in size; but serious innovations, however tempting they may look, are best avoided. With this view we propose, in conclusion, to present some examples of air-furnaces of foreign construction and proved to work well, and also some others of British formation in a subsequent paper, in which we shall also treat as fully as is useful upon the management of reverberatory furnaces in work.

Heavy bronze castings, as for stem and stern posts, screw propellers &c., have now come to be such usual tasks of the iron-foundry in many of our large marine-engineering establishments, that we shall not be deemed passing beyond the bounds of these papers on iron-founding, if we present also some designs of reverberatories specially suited to melting bronze; for although any reverberator that will melt iron, will, *à fortiori*, melt bronze, it is by no means true that the forms best for one are also those best for the other.

Figs. 1 and 1$^b$ show a reverberatory furnace for melting pig-iron employed at the Royal Foundry at Berlin. Between 50 and 60 Prussian centners (1 Prussian centner equal to 113·5 English pounds) are melted in this furnace in 4 hours, after about 1½ hour has been spent in the preliminary heating. Fig. 1 is a longitudinal section of the furnace; fig. 1$^b$ a horizontal section. Both these figures are drawn to a scale of 1-48th of the natural size.

A is the hearth or fire-grate, B the charging-hole for the supply of the fuel; the surface of the grate is 18 inches below the top of

Fig. 8.



the bridge C. The covering arch D sinks towards the sumph E, at the lowest point of which is the tapping-hole F. The flame escapes through the flue G into the chimney. H is the opening for charging the furnace; it can be closed by means of a sliding pintill door. The progress of the melting can be observed through the spy-hole J. Two of these furnaces are placed side by side, with

the chimney-stalk between them. The inclination of the sole or bed of the furnace is about 1 inch to the foot running, and the surface can be raised or lowered by increasing or reducing the bed of clay and sand forming it, according as the quantity of iron to be melted is more or less.

The area of the sole of this furnace is about 42 square feet, and the area of the fire-grate about 10 square feet; the proportion between the two being thus $\frac{4\cdot2}{1}$

Figs. 2, 3, and 4 represent a reverberatory furnace employed at the foundry of Herr F. Wöhlert, of Berlin, for the melting of iron. Fig. 2 is a longitudinal vertical section, fig. 3 a horizontal section, and fig. 4 a transverse vertical section through the tapping-hole; the figures being to scale of 1-48th the natural size.

This reverberatory furnace differs a good deal from those usually employed for the melting of pig-iron. The iron is charged through the door A upon the sole of the furnace, but at a certain distance from the bridge. The flame, passing from the fire-grate C over the bridge, meets the solid iron at B. The fuel is supplied through the fire-door D. The iron, as soon as molten, flows into the sumph or pool E, whence it is tapped off by the side of the furnace. The pool E is for this provided with a hole F, which is closed during the melting of the iron by a stopping of fire-block; the tapping-hole is perforated through that fire-block, and in front of it is the shoot G. The spy-hole H serves for observing what is going on inside. The flame escapes on the narrow side of the furnace through the flue J and an underground channel into the (in this instance) somewhat distant chimney. The total area of the fire-grate is $12\frac{3}{4}$ square feet, and in it there are 27 fire-bars, which have a free space between them of 7-16ths of an inch; the free surface of the grate is thus only $3\frac{1}{3}$ square feet, or only about one-fourth of the total area. This appears small. The area of the cross section above the bridge is $5\frac{2}{3}$ square feet, thus 1·7 times larger than the free surface of the grate; the area of the flue is $3\frac{1}{4}$ square feet, or almost as large as the free surface of the grate. These proportions differ very considerably from those of other reverberatory furnaces, especially English ones. The consumption of fuel was stated to vary, and to be from 27 to 36 lbs. of coals to the 100 lbs. of iron melted, and the time required for melting 50 centners of cast-iron at about four hours and a-half, which amounts to a yield of about 1,200 lbs. of iron per hour.

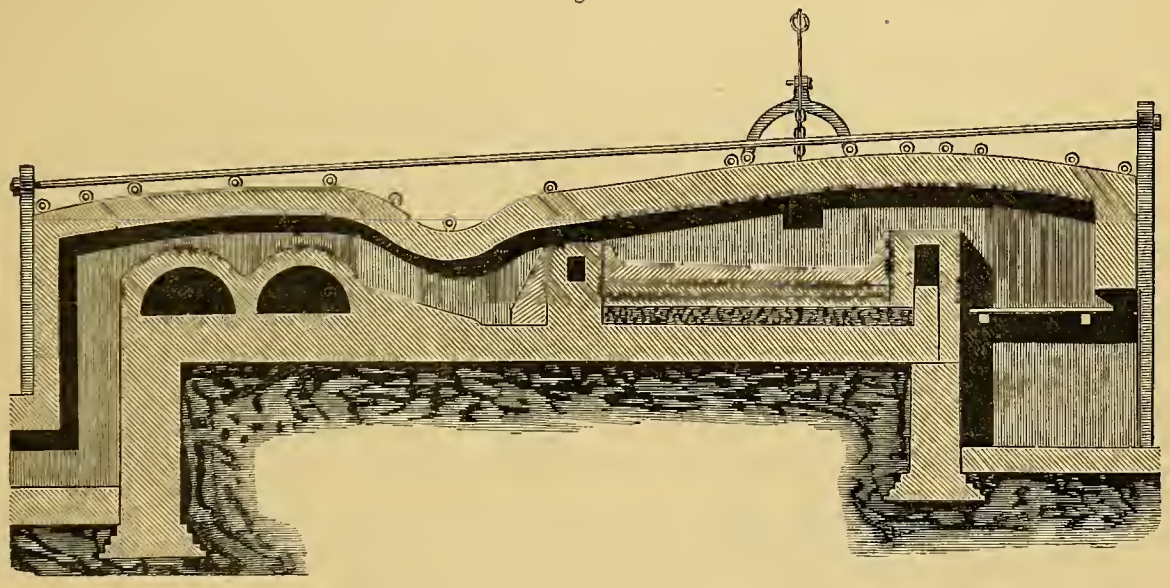
Figs. 5, 6, and 7 show a well-designed reverberatory furnace for cast-iron as adopted by another extensive foundry of Berlin. Fig. 5 is a longitudinal vertical section, fig. 6 a horizontal section, and fig. 7 a transverse vertical section near the tapping-hole; these figures are also drawn to 1-48th of the natural size. As may be seen from the figures, the sole A of the furnace is shaped like a trough, and in horizontal projection or plan it tapers in by curved sides towards the tapping-hole B and the adjoining flue. This, as well as the way in which the covering arch D is constructed, appears advisable. The fire-grate E has a total area of 14 square feet, and the bed or sole of the furnace has a surface in horizontal projection of about 42 square feet; so that the proportion between the two is as 1 : 3. The fuel is supplied to the grate through the fire-door F, and the sole is charged with metal through the door G. The spy-hole H opposite the bridge enables the progress of the melting to be seen. I I I are merely square holes in the brickwork to facilitate the escape of moisture on first heating the furnace. Between 40 and 50 centners of iron can be melted at once in this furnace, and, from the proportions of the furnace, that should be effected in $3\frac{1}{2}$ to $4\frac{1}{2}$ hours.

The cast-steel melting furnace of Mons. Sudré (see *Pract. Mech. Journal* for 1st March 1869) is shown in side elevation and in longitudinal section in figs. 8 and 9. Although proportioned as here shown, it might be employed for the fuzion of cast-iron. Its proportions would be advantageously changed for the latter use. The sumph should be deeper and shorter, and the covering arch modified to suit, and so expose a smaller surface of the fluid cast-iron, in proportion to its mass, to the action of the flame &c.

We are not aware that any trial has ever been made of adapting to the case of cast-iron Mons. Sudré's method of effecting the fuzion beneath a stratum of fuzed glass, whose chemical construction should be that of a neutral silicate. This method, which proved effectual in preventing any alteration in the constitution of cast-steel in fuzion beneath it, could not but prove equally so in precluding alteration in cast-iron, whose fuzing point is lower. No doubt this sealing up floating coat of glass, which is not a very good conducting material, must waste some fuel; and it is to be held in view that the action of furnace flame and gases is capable of effecting certain changes in the chemical constitution of cast-iron exposed to them and heated, but yet remaining solid; and these changes may be of a deteriorating character. The glass itself costs nothing, for broken French wine-bottles are in composition sufficiently near to a neutral silicate.

The two large brick muffles in Mons. Sudré's furnace, seen to the left of the fig. 9, were intended for heating his steel ingots up to as high a temperature as possible by radiated heat from the white-hot walls of the muffles, without any exposure to the flame and gases of the reverberatory until at the last moment, when they are in succession rapidly thrust down below the fuzed bath of glass. Were it necessary for any special purpose, there is no doubt this method might also be applied to pig-iron; but the place of these muffles would be best occupied by a nest of pipes, properly dis-

Fig. 9.



posed, so that the escaping heat of the reverberatory might be employed to heat the blast with which M. Sudré urged the draught of his furnace, in addition to that produced by the chimney-stalk. In our next paper, however, we shall recur to this in making some remarks upon the use of reverberatories with gaseous fuel. Ed.

## REMARKS ON CHILLED PROJECTILES.

The production of chilled and hard cast-iron elongated projectiles —the so-called Pallisser shot and shell—has been by special order suspended at Woolwich Arsenal. Of that we believe there is no doubt whatever, and quite as little as to the sufficient grounds for the order, namely, that several of these projectiles of the largest size have been found at the instant of discharge to break up in the gun, and the separated fragments to have destroyed the rifling by the rough tearing contact of their harsh and angular fragments, and so rendering the gun perfectly unserviceable. This is undoubtedly an unpleasant event for Major Pallisser's pretensions, especially as coming at nearly the same time as the award of Mr. Gregory, the President of the Institution of Civil Engineers. If we are rightly informed, that gentleman was fixed upon by the War Office itself to be the sole arbitrator as to whether Mr. Parsons, C.E., or Major Pallisser was really the originator, and entitled to a public reward for the invention and introduction of the method of strengthening (tinkering up, rather,) old smooth-bore cast-iron guns, to convert them into unsafe rifles.

The arbitrament, pressed for it seems by Mr. Parsons, was certainly undertaken at an unluckily late period, if it be true that Major Pallisser had been already for some time in possession of some 15,000*l.* of reward handed him for these gun-altering methods, and those so-called Pallisser projectiles. However, we must presume Mr. Parsons' case was too strong to resist examination at least, although he stood in the unhappy position of being "only a civilian," and so the War Office, perhaps not quite rightly judging their man, refused, we understand, to let Mr. Parsons have any voice as to the arbitrator to be chosen, and *ex parte* fixed upon Mr. Gregory. They could not have chosen a more upright and honourable, as well as clear-sighted man.

The arbitrator, it seems, soon decided what all the outside world had seen long ago, except, indeed, Major Pallisser and his friends in office, that there was in fact no real difference between the gun-altering methods of Parsons and of Pallisser. The question of rivalry thus resolved itself simply into one of date—which champion of two bad methods nearly identical first brought his plans before "the authorities?"—and here it seems that Mr. Parsons was able to show something like a two years' priority to Major Pallisser. Now, if any one has to be rewarded out of the nation's purse for contriving a plan for rendering *possibly* useful smooth-bore cast-iron guns wholly unserviceable, useless, and unsafe as insignificant cast-iron and steel rifle guns, it is—if all the above be facts, as we have reason to believe they are—Mr. Parsons; but Major Pallisser has already been rewarded. When just a *little too late*, the authorities having already enabled the wrong man to dip into the national purse, the right man is found through their own chosen arbitrator.

What is to be done? We know not, and happily have not the duty to decide in such a dilemma; but we hear that, as the best and most comfortable road out of the mess, it is suggested that Mr. Parsons ought to be now rewarded also. How can he, the right man, be offered less than the wrong one has already got? Well, if so, 30,000*l.* of John Bull's money does seem a tolerable pull for two inventors of the same thing; the invention itself being worth precisely nothing, as either is already proved, or will be sure to be proved in the course of "Time, the revealer." Now, if these statements be even based in fact, what a comment do they afford upon Mr. Macfie's precious project for a grand national machinery for rewarding invention in lieu of the patent laws! which that sapient M.P. deems it his own policy to assail. What a nice prospect is presented by jobs such as this, multiplied by ten thousand each year!

Well, let us return to the chilled projectiles. We have no intention of returning over the old vexed ground of whether Major Pallisser was the inventor either of shot cast in chills, or of white cast-iron in chills or in sand, or even the first to point out that the harder the material of the shot the better for breaking through armour plate &c. Those points we believe perfectly well settled in the minds of all unbiassed men having the adequate amount of information before them, and adversely to any claim set up by Major Pallisser. Major Pallisser's merit consists in and is limited to this, that he persistently pressed upon the authorities what had been already laid before them by others, and by well-known facts, and that he devoted a good deal of otherwise leisure time to superintending experiments in the shell-foundry at Woolwich, by which (at the public expense however) he was at last able to make the pachydermatous creature "authority" sensible that the hard cast-iron shot was the right thing. For having effected this, let neither due fame and recognition, nor substantial reward, be withheld from him. We should be as eager to see justice so done to him as any of his most official or influential friends. And we are now about to give some little proof of this liking for fairplay on *all* sides. We have always affirmed that the attributing the superiority of these hard white cast-iron projectiles to their having been cast in chills was in great degree an error, not to give it any harder name.

Cast the projectiles how we may, if we make them hard enough they will be all right; but they must be hard to the very core; if not, their having been chill-cast will be useless and a mere delusion. Now, unless the cast-iron be *ab initio* white, like "*finery pig*," no chilling possible can make a large (9 or 10 in.) elongated projectile hard to the core; and if the iron be of this quality, the chilling is of secondary importance. But, nevertheless, it *is* of importance in another way, if not in more than one other way; and hence we deem Major Pallisser's originally proposed notion—viz. that these projectiles should be chill-cast—still the right one, and we adhere to that notwithstanding the untoward breaking up of these shot in the guns. Why do they break up? The reason is this; when the rigid and, within very narrow limits, highly elastic white cast-iron is chill-cast, the projectile when cold has its particles under permanent and tremendous internal strains, due to its outside coats having got solid before the interior ones. These strains vary much with the sort of metal, and with very slight changes of conditions under which it is cast and cooled. It is sometimes so enormous that some of these hard projectiles have been discovered split spontaneously as they lay quietly in the heaps in store at Woolwich. When one of these projectiles then, with a maximum of internal strain existing in it tending to make it split open with a force already nearly equal to the whole tensile resistance of the material, is fired from a gun, the outside layers of metal are instantaneously heated, and powerfully, by the flame of the ignited powder, the temperature of which, in the case of one of these heavy guns, is certainly not under 3,000° Fahrenheit. The projectile is thus exposed to the same conditions as a badly-annealed glass tumbler is when suddenly filled with boiling water; in literal fact, such a projectile is only a big Prince Rupert's drop in another material than glass, and when either violently scratched or let fall, or struck, or suddenly heated, it breaks up quite in a way analogous to those glass toys which bear the fervid and ingenious Rupert's name.

Now, what is the obvious remedy? Simply anneal these chilled projectiles after they have been cast; and, if done in a proper manner, all danger of subsequent splitting-up will be at an end. But we repeat, anneal *in a proper manner*. If these projectiles be put into an annealing oven, and heated to a good bright red heat, and exposed to that for longer or shorter time, the molecular *structure* of the cast-iron, and perhaps even its chemical constitution, will become so much changed, and their hardness so much reduced, as to render them of very depreciated value as projectiles. But no such temperature is necessary. As soon as ever the iron is "set," *nearly* or quite to the heart, let the projectiles be shaken out of their chills, and at once transferred to an annealing oven, heated to about the temperature of fuzion of zinc—say 700° to 900° Fahrenheit—and there let them rest (guarded well from any oxidating currents of air or gases in the oven) for a sufficient length of time; at the end of which it will be found that all internal strains have slowly got removed, and there will be no longer any danger of spontaneous splitting, or splitting in the gun.

*How* long the period for this annealing at a low temperature (one enough to permit rearrangement or adjustment of particles, but not enough to induce molecular segregations of graphite, or other injurious changes internally), nothing but experiment can decide ; it must be long—probably for 9-inch or 10-inch solid projectiles, not less than 10 or 15 days—and it will vary with the size of the projectile and with its precise metal and the conditions of casting. It would be, we think, a subject of regret if those accidents should result in the abandonment of the method of chill-casting, and the return to that of dry sand-casting ; and for two reasons. First, although, by the latter mode of casting, the projectile may be, we doubt not, made as hard as is desired, yet, the internal crystalline arrangement of the iron will never prove as regular and as good for the purpose of a projectile as if chill-cast. Cast in the latter way, the long axes of symmetry of all the crystals are arranged with the most singular and beautiful symmetry, in lines normal to the exterior contour or surface of the solid, and to both exterior and interior surface of hollow projectiles. In these positions, they present themselves in the most advantageous possible way to resist impact with, and rupture through, a partially rigid solid, such as a tough armour-plate. The crystalline particles are thus *better* arranged in the chill-cast than in the sand-cast projectile. We had best not sacrifice this advantage without inevitable necessity.

Secondly, although up to the present time, notwithstanding the advantages of Major Pallisser's personal labours, and the great opportunity for observation and experience available to all others engaged in the shell-foundry with these projectiles, considerable difficulties still arise in producing them to exact calibre ; and when this exceeds a very narrow major limit, the rigidity of these projectiles being so great, these large ones cannot be rammed home, or stick in the chase on discharge, so as to endanger the gun. This evil, we make bold to say, a really experienced and scientific iron-founder would soon see his way to rectify ; and when accomplished, the chilled shot would be found a far more accurately calibrated one than any sand-cast projectile of the same nature is likely to become, even in the most skilful hands.

The practical iron-founder who reads these lines will at once discern that the method of low-temperature annealing, which the writer has suggested, is in fact the first step at the same time towards precise and uniform calibration. Those who are not familiar with the crystalline structure of white cast-iron, and the effect of this on the resisting powers of these projectiles, will do well to consult the third of the Cantor Lectures, lately delivered by Mr. John Anderson, C.E., of Woolwich Arsenal, at the Society of Arts, Adelphi, where it has been lucidly explained and illustrated. These clever lectures are published in the Transactions of the Society of the last few weeks.

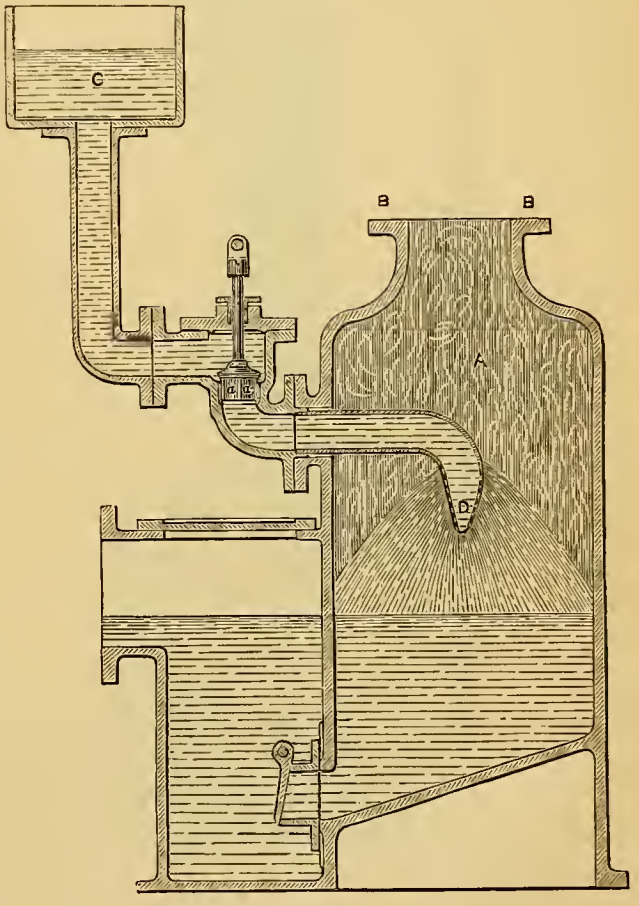
## THE BLOW-THROUGH CONDENSER.

After more than a century of labour on the part of those who have made it their endeavour to produce a more efficient steam-engine condenser than has hitherto been known—after all that has been theorised and written on the subject—after the accumulation of an almost unexplorable mass of information compiled by various experimenters and observers as to the merits and demerits of the different arrangements of condensing apparatus, as to the superiority or inferiority of the surface condenser over the injection condenser, both for special as well as general application—it was scarcely to be expected that in these latter days a return would be made to the oldest condenser of all, which, now that it has received the attention which the proper appreciation of its action shows it to have deserved, is proved for certain applications of the steam-engine to be of vast importance ; and we even feel disposed to make bold in saying that no existing condenser is equal to it in the points of simplicity, economy of construction, and non-liability to derangement ; while, for that class of engines to which it is applicable—namely, those from which the steam is exhausted *above* the atmospheric pressure—it is unquestionably superior to any.

The principles of action upon which the "blow-through" condenser depend were known and employed, but not appreciated, as early as 1698, at the time when Captain Savary devised his water-raising apparatus ; the water in the later arrangement used by him being admitted into, in lieu of outside, the condensing vessel alternately with the steam, and expelled therefrom by the pressure or impulse of the latter ; and the vacuum formed therein ; in fact, these operations were then made to succeed each other just as they take place in the "blow-through" condenser applied to the steam-engines of to-day. Newcomen, too, in his engines of later date, employed a similar condensing arrangement; that is to say, in using the lower part of his cylinder as the condenser, he admitted the condensing water therein alternately with the steam, formed the vacuum, and blew the water out (by the readmitted steam) through a water-locked valve chest into a surrounding cistern.

As we are not at present writing a history of the steam-engine, it is sufficient here to state that its generally wasteful nature at this period led Watt to the idea of condensing in a vessel other than the steam-cylinder ; and the principles of the "blow-through" condenser were for a long time lost sight of, the air-pump condenser becoming the apparatus to which mechanicians looked as the great helpmate of the steam-engine.

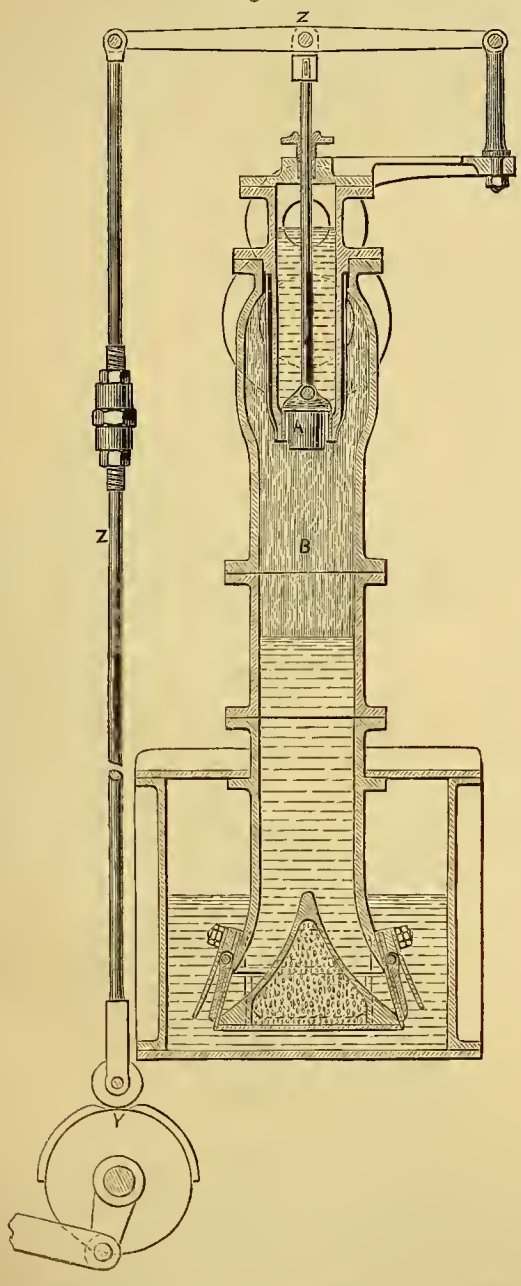
Fig. 1.




Nearly a century ago, however, after the condensation of the steam in a separate vessel had received wide application, the employment of condensing apparatus based on the principles long previously used by Savary and Newcomen was resuscitated by Hornblower in 1781, when he obtained his patent for the "combined engine," in which the steam, after performing its work in one cylinder, was allowed to expand into larger volume at less pressure, and act upon another piston in a larger cylinder. This same Hornblower at this period also gave birth to the idea of the surface condenser, as the following passage from his specification clearly shows :—"Thirdly, I condense the steam by causing it to pass in contact with metalline surfaces, while water is applied to the opposite side." Then, as to the "blow-through" action of the

condenser, he adds—"Fourthly, to discharge the engine of the water used to condense the steam, I suspend a column of water in a tube or vessel constructed for that purpose, on the principle of the barometer, the upper end having open communication with the steam-vessels,* and the lower end being immersed in a vessel of water. Fifthly, to discharge the air which enters the steam-vessels with the condensing water or otherwise, I introduce it into a separate vessel, whence it is protruded by the admission of steam. Sixthly, that the condensed vapour shall not remain in the steam-vessel in which the steam is condensed, I collect it into another vessel, which has open communication with the steam-vessels and the water in the mine, reservoir, or river."

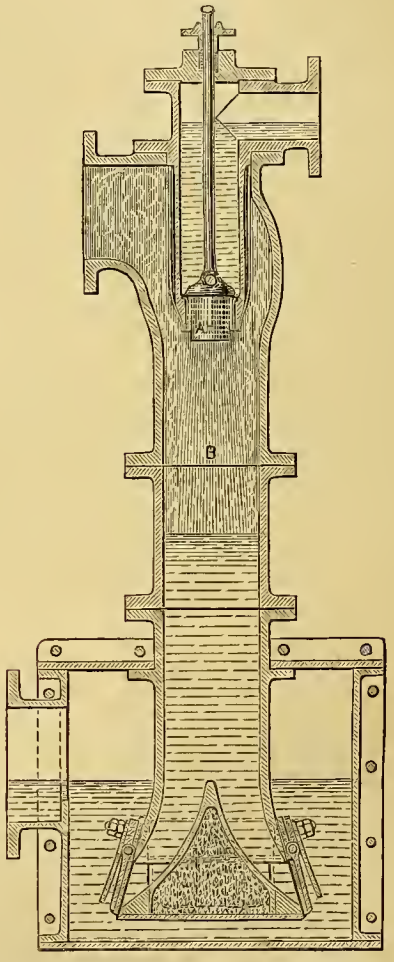
Fig. 2.




It is interesting to notice, from the references we have now given, how long a time sometimes elapses before a great thought is duly understood in all its greatness. These men of a century and more since, from whom we have received ideas, and on which we have worked with such advantage in these latter days, had not any adequate conception of the exquisite sufficiency of the principles which they were putting into practice, of the means with which they were dealing. The very thought that revolved in their brains is the same which actuates us now, different only in so far that we have had the opportunity of examining it for a longer time and comparing it with other things of which we have certain knowledge; so that ultimately the whole importance which has underlain it has come out to be duly appreciated. Hornblower did not see that one vessel was sufficient for condensing the waste or exhaust steam, for discharging the condensing water and condensed steam and air and the remaining aqueous vapour, but since then it has been seen that one vessel or chamber is sufficient for the whole of these effects to be produced; and in the "blow-through" condenser of to-day these are achieved.

At what date condensers of this class were first applied we have not been able to ascertain; yet we know that in Scotland "blow-through" condensers of a most imperfect type have been long in use, but they were defective in this respect, that it was the practice of the older engineers to make the condensing chamber very large, we believe in many cases nearly as large as the engine cylinder. Now, a vessel of such dimensions will

Fig. 3.




carry an enormous weight of water in comparison to the weight of steam to be condensed; and the result was that, with so large a quantity of water in the condenser, when the engine commenced work, the steam was condensed and the water heated, but not blown out as intended; indeed, the water was not blown out by the exhaust steam until it had come to the boiling point by the heat therefrom imparted to it, so that, in place of acting as a *constant* vacuum-forming condenser, these old "blow-through" condensers produced a partial vacuum for the first stroke of the piston, after which it gradually diminished until the condensing water was boiled by the heat given up to it by the exhaust steam, which point being reached, the water could condense no more steam;

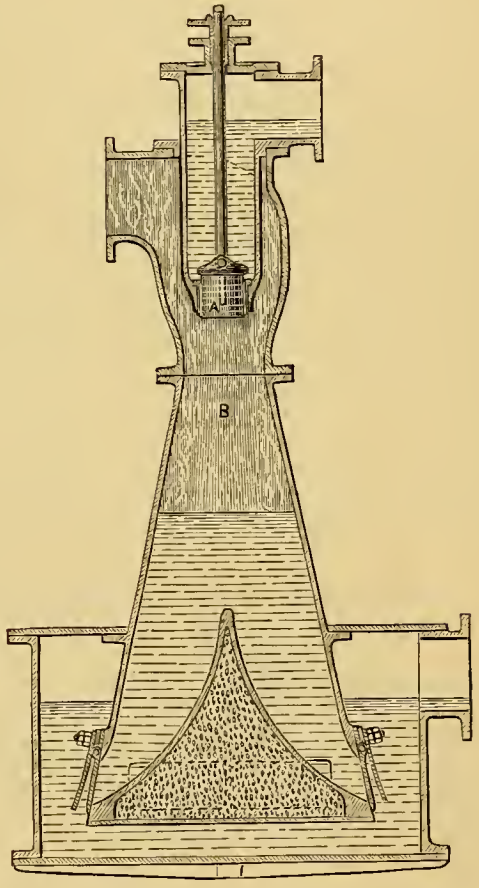
* Hornblower called the cylinders "steam-vessels."

it was then forcibly ejected from the condensing chamber, when a fresh supply of cold water being admitted, a similar result followed. It will be clear to any mind which grasps this subject, that with such a state of things no regularity in the working of the engine could be looked for, and various devices were sought after to remove the sources of annoyance thus created. At last it was perceived that the condensing chamber was too large, and some engineers decreased its capacity by filling it with stones, and in fact any solid matter which came in the way that could be thrown into it; this diminished the capacity of the chamber for water, and of course generally improved the action of the apparatus; for as the bulk of water was less, it was blown out at more frequent and shorter intervals. Yet withal, the "blow-through" condenser was a most troublesome and unreliable appliance, and consequently it gave place to the air-pump condenser. To so far improve the "blow-through" condenser that it has become a highly efficient adjunct to the steam-engine, we are indebted to Mr. Andrew Barclay, F.R.A.S., of the Caledonia Foundry, Kilmarnock. In 1854, as a provisional specification filed by him in that year clearly shows, he had so improved the old condenser that it could be applied with all the advantages of any other condenser to *slow*-working engines; but as then arranged, it did not succeed for engines running above twenty double strokes per minute. For some time before that date, and up to the present time, Mr. Barclay has continually been constructing these condensers, and has applied them to dozens of engines in Scotland and the north of England.

Until very recently, these condensers have been made as shown in vertical section at fig. 1, in which A is the condensing chamber, the exhaust steam escaping thereinto from the cylinder by a passage connected to the flanch B. The injection-water is supplied to the cistern C, and at the termination of each stroke of the piston the valve *a* is lifted (by a cam driven by the engine); thus the injection-water is allowed to flow into the chamber A, into which it passes in the form of spray through the perforated nozzle D. The action of the condenser is thus: The impulse of the exhaust steam in entering the chamber A produces a blow or pressure on the surface of the water, and expels or blows it out through the foot-valve E into the chamber F, from which it flows as hot feed-water into the hot-well; a portion of the steam also passes out with the water, and the remaining portion of the steam which remains uncondensed after the expulsion of the water is immediately condensed by the injection-water passing in through the nozzle D. Mr. Barclay has made condensers according to the pattern shown at fig. 1 for the last fifteen years, and they are still in operation with many engines in Scotland and the north of England.

Further experience has, however, shown that the condensing chamber might with advantage be made considerably smaller than hitherto, and it has been found in practice that the action of the condenser is much more certain and rapid if the chamber is made high and of narrow diameter; for by so arranging it the weight of the column of water tends to cause its escape through the foot-valves with greater rapidity than when it is spread out in a flat layer of large area but shallower depth, as in the older forms, of which fig. 1 is an example. We illustrated some of the later forms of this condenser at fig. 3, plate 6; also at figs. 17 and 18, pages 87 and 88 of the present volume; but these have since been further improved upon, that is to say, the condensing chamber has been made longer. To illustrate this we now refer to woodcuts 2 and 3, which are vertical sections, at right angles to each other, of a condenser being fitted to a large pit engine at the works at Addiewell of Young's Paraffin Light and Mineral Oil Company, Limited. Fig. 4 is also a section of another improved form of the condensing chamber. In our former illustrations the valve openings by which this injection-water is admitted were shown of the same, or nearly the same, diameter as the condensing chamber. It is, however, found by Mr. Barclay in practice that the diameter of the condensing chamber should be as nearly as possible equal to that of the exhaust-pipe, whilst the diameter of the injection-valve may be very much less than that; as shown at A and B in figs. 2, 3, and 4. In the Addiewell condenser, as shown at fig. 2, the injection-valve A is lifted by means of a cam *y* driven by the engine, which acts upon and raises the rod and lever *z*. At fig. 6, page 105 of the present volume, we gave a skeleton diagram from an engine fitted with one of these blow-through condensers, and at that time merely pointed out the efficiency of the vacuum formed by the condenser and the temperature to which the escaping water was raised. It has since occurred to us that the reference we then made to the diagram was scarcely sufficient to enable it to be fully understood, seeing that it is one of a form not commonly to be met with, and hence liable to be misunderstood. The engine from which the diagram was taken is practically a non-expansive engine; that is to say, it receives steam

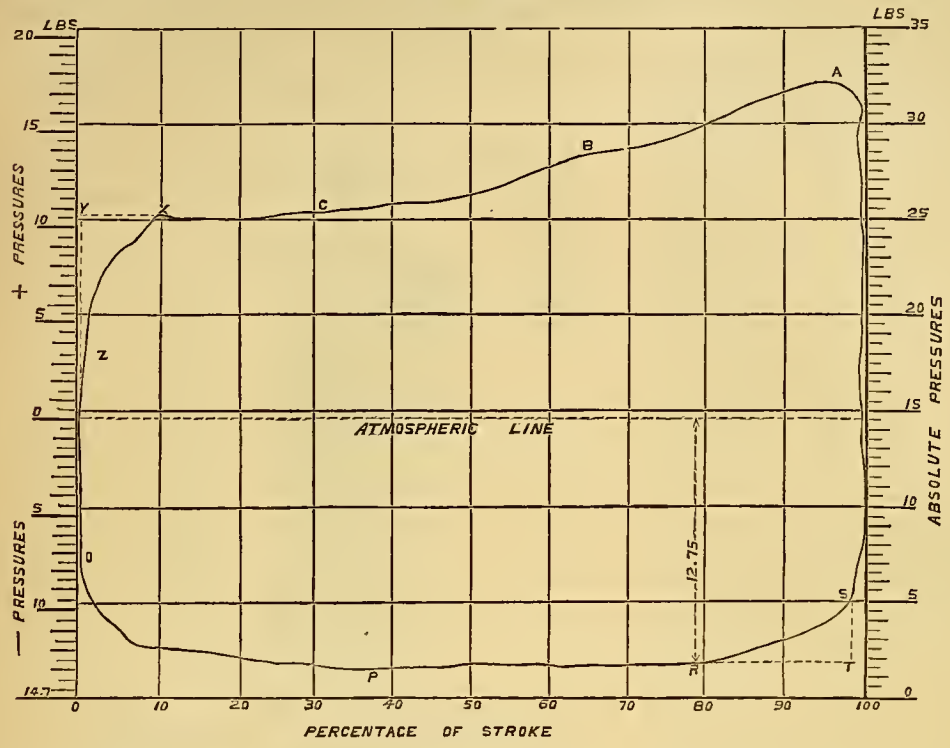
Fig. 4.




throughout nearly the entire length of the stroke, the steam being cut off at the point *x* of the diagram as now shown at fig. 5. The long expansion curve, however, A B C *x*, requires explanation. It does not represent a fall in pressure due to expansion in the cylinder, but as the steam port of the cylinder is of larger area than the throttle-valve opening, the steam is taken away by the steam port into the cylinder at a greater rate than it is supplied by the throttle-valve. Thus at the termination of the stroke—or, in other words, during the interval of time between the cut-off of the steam (which, as before alluded to, is in this case very nearly at the end of the stroke of the piston), and its readmission for the return stroke—the steam reaches in the steam-chest the full pressure due to the boiler, and with which it acts on the piston at the very commencement of the stroke; but as it is taken away by the cylinder at a greater rate than the throttle-valve admits it, the steam pressure in the cylinder gradually falls, and thus produces the curved line A B C *x*, in the diagram under reference. From this defect in the construction of the engine the pressure falls from 32·5 lbs. at the beginning to 10·5 lbs. at the termination of the stroke, the exhaust takes place simultaneously with the cut-off, so that the pressure at once falls, and the area *x y z x* in the diagram represents the consumption of energy due to its expansion into the condenser, and the blowing out of the water remaining therein from the preceding admission of the injection-water. The injection-

water is now admitted, which instantaneously condenses the residue of exhaust-steam, so that the pressure falls very rapidly at first, as indicated by the vertical line *z o*, and then gradually as represented by the irregular curved line *o p*, after which the vacuum continues to its full amount of – 12·75, until 80 per cent. of the stroke is made, from which point a compression of the residual vapour in the condenser takes place as indicated by the curve *r s*; the loss of efficiency in the vacuum being indicated by the area *r s t v*. At the point *s*, by the lead of the slide-valve, steam is re-admitted, and at the point *u* the slide-valve opens the port to its full extent, when the high-pressure due to the boiler is at once reached, as indicated by the vertical line *u* A.—V. D.

Fig. 5.




## THE BREASTWORK MONITOR *CERBERUS*.

(*Illustrated by Plate X.*)

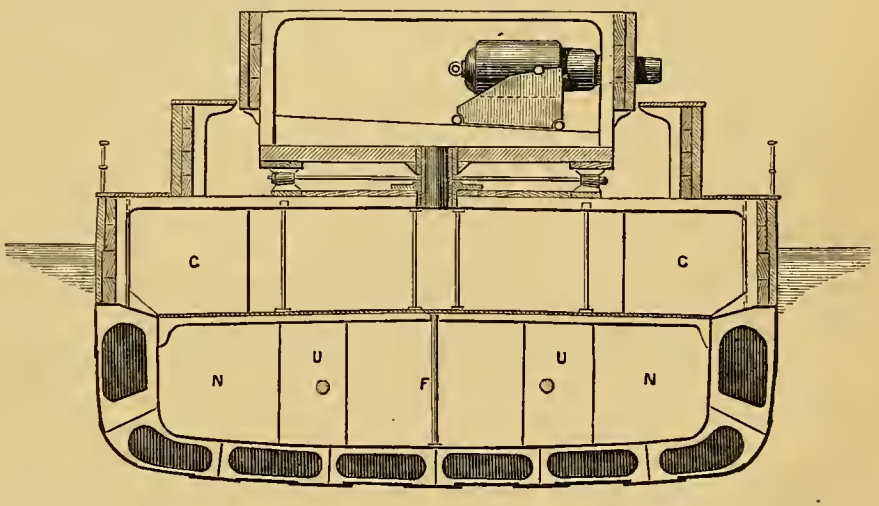
The completion of the *Cerberus*, an armour-plated monitor, intended for the defence of Melbourne, built by the Palmer Co. of Jarrow-on-Tyne from the designs of Mr. E. J. Reed, C.B., the Chief Constructor of the Navy, affords us a favourable opportunity of presenting our readers with some detailed information respecting that ship, as well as with a few general remarks respecting the class of monitors of which she is the first example. The accompanying plate and wood engraving illustrate the principal features connected with the structure, stowage, armament &c. of this vessel, and, with the numerous references attached, will prove worthy of a careful study, as they show how the novel conditions of the design have been met, and indicate the general character of the arrangements in our other breastwork monitors. There are now five of these vessels building in this country, two being intended for the defence of Bombay, and being constructed for the Indian Government, while the remaining three will constitute the first monitors added to our own Navy. Of the Bombay monitors, one, the *Magdala*, is a sister ship to the *Cerberus*; the other, the *Abyssinia*, is a rather smaller but similar vessel. The monitors for our Navy are larger and very much stronger than the *Cerberus*, but they are identical in type with that vessel. One of them, the *Glatton*, is a single-turreted ship, and is the only turret-ship we possess which is thus constructed; the other two, the *Thunderer* and *Devastation*, are the sea-going monitors, the design of which elicited such a lively discussion on the passing of the Navy estimates for this year. As it is impossible, within the limits of a single article, to give descriptions of all these vessels, we shall principally confine our remarks to the *Cerberus*, making only incidental references to the others.

At the outset, however, it may be well to call attention to the fact, that the Breastwork type of monitor is, on the whole, very different from the American type introduced by Mr. Ericsson. There are, it is true, many points of similarity; notably, the small height of upper deck above water, the almost flush character of the decks before and abaft the turrets by which the full command of the horizon with the turret guns is secured, and the overhanging stern by which the rudder is protected. The means by which the ventilation of the ship is performed, the general arrangement of the hold, and the means of propulsion, are also similar in the two types; and it is only fair to the Americans to admit that the improved arrangements in these respects of our monitors are, in a great measure, the result of the experience they have had in their monitors during actual service. But, while there is this similarity in some respects, there are, as we have said, many important differences between our monitors and the American. Chief among these stands the so-called "breastwork" arrangement, which is fully illustrated by the sections and plan of the *Cerberus*. On reference to these it will be seen that in the central part of the upper deck a space is enclosed by an armoured wall, or breastwork, between 6 and 7 feet high. The space thus enclosed is in length about half the length of the vessel, and is about three-fourths her breadth. In it are placed the turrets, the funnel, the air or ventilating shaft, and the principal hatchways over the boiler space &c. Upon the top of the breastwork a complete deck is built, and is strongly plated; thus protecting from depressed or dropping fire the interior of this part of the ship, and particularly the turret engines, the turret beds, the steering-wheel, and other important fittings placed within the breastwork upon the upper deck proper, as shown upon the plan of upper deck of the *Cerberus*. All the principal openings, where water would be likely to enter when the ship is in a sea-way, are thus brought up to a height of ten or eleven feet above water, and the turret guns are carried eleven or twelve feet above water, notwithstanding the lowness of the free-board. In fact, the only openings in the upper deck outside the breastwork are those made for the skylights, over the spaces in which the officers and men are quartered (marked s s s in the engravings); and these openings are protected by strong armour-plate coamings, to which armour-covers, or battle-plates, are fitted, so that they can be closed at sea or in action. The only openings into the interior of the ship are practically, therefore, those in the breastwork deck; and this deck would probably be clear of water except in very heavy weather. In such weather the openings in this deck also can be closed, as they are fitted with water-tight trunks, or casings, and then the hurricane or flying-deck that stretches along over the turrets would be used, access being gained to it by means of water-tight ladder-ways, as shown in the longitudinal section of the *Cerberus*. It will be seen also that the steering-wheel ordinarily employed is placed on the hurricane-deck, and the officer in charge would direct the navigation from this deck also, except in action, when he would take his

station in the armoured pilot-tower, and the ship would be steered by means of the wheel placed just below within the breastwork space.

The American monitors have hurricane-decks, but no breastwork, or deck corresponding to the breastwork deck. In them the turrets stand upon the upper deck itself, being carried by a central spindle, which passes down through the deck, and the junction of the turret-base with the deck is consequently only three or four feet out of the water. Separate protection has also to be given to the bases of the funnels and air-shafts, since, if these were shot away, water might pour into the hold through the openings, and sink the ship; and to all the openings in the low deck armour-covers, or battle-plates, have to be fitted, the ship's safety depending, in a great measure, on the water-tightness of these covers, as the fate of the *Weehawken* showed. In short, all these openings are at a height of three or four feet only above the water, instead of being ten or eleven feet, as in our breastwork monitors, and the liability to loss is thus greatly increased. Besides this, the turret guns are much nearer the water in an American than in a breastwork monitor—a matter of the highest importance when the fighting efficiency of a ship is being discussed; and Mr. Fox, the Assistant-Secretary of the Navy, has drawn attention to this feature of American monitors in his report on the Trans-Atlantic voyage of the *Miantonomoh*. In weather when the *Cerberus*, and ships of the same class, would be perfectly capable of fighting their guns, it is affirmed that the American monitors would be powerless, owing to the sea washing over the turret ports and preventing their being opened or turned to windward. As compared with the American plan, therefore, it is submitted that the breastwork system gives both greater safety and increased fighting efficiency in a sea-way, and is on that account much superior. It may, however, occur to some of our readers that this superiority has been purchased by using much greater weights of armour than would be used in American vessels; and there is no doubt that at first sight this appears probable. A closer examination shows that this is not the case, and that the weights of armour and deck-plating required by the two plans are, as nearly as possible, identical. From a discussion that took place at the Institution of Civil Engineers some time ago on "Ships of War" (introduced by Mr. Bourne), it appears that Mr. Reed had gone carefully into this aspect of the subject before finally adopting the breastwork system; and it is quite possible to see, in a general way, why this system does not require greater weights of armour than the American, or Ericsson, system. As we have said above, in an American monitor the bases of the funnels and ventilating shafts, and the hatchways require to be separately protected, while the turrets have to be armoured from roof to base. In the English plan only the part of the turrets showing above the breastwork require to be armoured, and the breastwork protects all the other parts just enumerated, besides which the position of the upper deck, enclosed by the breastwork, does not require to be plated over; and the plating on the breastwork deck need not be as strong, or as heavy, as plating for the same area on the upper deck would have to be made in order to give equal protection. These are some of the principal causes which, it is alleged, prevent the continuous breastwork from requiring a greater weight of armour than would be used if the American system were followed.

We must now pass on to the *Cerberus*. Her principal dimensions are:—Length between perpendiculars, 225 feet; breadth, 45 feet; draught of water, 15 feet 6 inches; tonnage, 2,107 tons B. O. M. She has twin screws driven by independent engines having a collective power of 250 horse-power nominal, working up to about six times. Her estimated speed was 8 knots, but there is good reason for anticipating from her performance on her voyage round from Newcastle to Chatham that this speed will be exceeded. Her upper deck is 3 feet above the water, and her side is armoured down to a depth of 4 feet below water. The side armour above water is 8-inch, that below water 6-inch, and the teak backing 9 and 11-inch, the skin plating being 1¼-inch. Although of such moderate dimensions this vessel carries thicker armour than any of our iron-clads yet commissioned, except the *Hercules*. On the breastwork most of the armour is 8-inch, but in wake of the turrets 9-inch armour is employed. On the turrets there is 9-inch and 10-inch armour, the greater thickness being used at the ports. Each turret carries two 18-ton guns throwing 400-lb. shot, and is supplied with two engines (T T in the plan) for turning it; turning gear to be worked by hand is also fitted, so that either manual or steam power can be applied. Every point on the horizon is commanded by the turret guns; and this is a feature which has been considered essential in all our monitors, even the *Glatton* with her single turret having command of the full circle of training. This uninterrupted command of the horizon is, or should be, viewed as highly important, if not the ruling principle in the arrangements of a ship carrying a turret armament; but, as we have shown recently in speaking of "Sea-going Turret Ships," it is almost, if not quite impossible to secure such a command in a full-rigged ship. The monitors, we need hardly say, have no masts, rigging, or sails, so that no hindrances to the fire of the guns exist, and the gain in this respect undoubtedly more than counterbalances the disadvantages resulting from the absence of sail-power. The Admiralty have in their recent sea-going monitors, the *Thunderer* and *Devastation*, signalised their opinion on this matter, and their supporters affirm that the opponents of this course, both in the House of Commons and elsewhere, have failed to meet the arguments advanced in favour of the substitution of an extremely large coal supply in these vessels for sail-power. No doubt many of the reasons stated for retaining sail-power in war ships are unanswerable when applied to *cruisers*, but these vessels, although sea-going, are not intended for cruising services. Their mission will probably be to proceed to the Mediterranean, or across the Atlantic, there fight a battle, and then return; or to lie in wait off some of our naval stations, such as Gibraltar, within easy reach of large coal supplies, and be prepared to meet any enemy. For such services the monitor type of ship, trusting entirely to her steam-power, is alleged to be undoubtedly superior to any full-rigged ship, whether armed on the broadside or turret principle.




In the *Cerberus*, her upper deck and breastwork deck are strongly plated, the one with 1½-inch plating and the other with 1-inch. In some of the larger monitors, such as the *Glatton* and *Thunderer*, 2, 2½, or even 3-inch deck plating has been adopted; but these thicknesses are, of course, associated with much stronger side armour and backing, 12 or 14 inches of armour, and 18 or 20 inches of backing. Proportionally to the strength of the side, therefore, the deck plating of the *Cerberus* is about as strong as that of the other ships. The care which has been given to strengthening the decks of these monitors has been well bestowed, for the war with the Southern States in America proved that the

decks were the weakest part of their earlier monitors, and in the later American ships deck-plating of much greater strength has been employed.

With respect to the structural arrangements of the *Cerberus* very little need be said, except that they afford one of the best examples of the application of the bracket-frame system, which, since its introduction under Mr. Reed's directions into the hull of the *Bellerophon*, has been gradually improved and perfected. The cross section of the *Cerberus* indicates these arrangements very fairly, and shows how the vessel's safety and strength are increased by the complete double bottom that rises on each side to the height of the armour. By this means, as long as the inner skin remains intact, no water can enter the hold; and while in all iron ships the plan is very valuable, in low-decked monitors it is especially important, since the margin of buoyancy is so small. Besides this provision the *Cerberus* has the usual water-tight bulkheads and partitions in the hold, by which her safety is still further increased. These bulkheads extend up to the upper deck, and their positions are indicated on the longitudinal section.

Many difficulties must obviously have been encountered in arranging the subdivisions, stowage &c., of this new class of ship, and in securing comfortable and healthy quarters for the crew. The ventilation is, of course, artificial, blowing fans worked by auxiliary engines being employed to distribute to all parts of the ship, through suitable channels, the fresh air that enters through the ventilating shaft (J in the engravings). The vitiated air escapes mainly through the turrets when the ship is in fighting or sea-going trim; under other circumstances it would also find exit up the skylights, ladder-ways &c. Great care has also been bestowed upon the drainage and pumping arrangements, and indeed upon the fittings generally; and, so far as one can judge from what is known of the American monitors, there is no reason to doubt that the various and special requirements of the ship have been satisfactorily met. It must be acknowledged that the Americans have taught us a great deal of what we know about monitors, and we have doubtless profited by both their successes and their failures, so that it might be supposed that our vessels would in some respects be superior to their American predecessors. Some advocates of the American type of monitor, however, think it incapable of improvement, and consider everything but unqualified praise to be equivalent to denial of its merit. In view of what has been said there can be little doubt that this type is both capable of being improved upon, and the advocates of the present designs allege that it has given place to a better type already in our Navy, since these breastwork monitors are equally capable of being adapted to fighting in shallow waters as the American ships, and are far more efficient when fighting-power at sea is required. While recognising American claims to the introduction of the monitor model, therefore, we may repeat the assertion made by many capable of forming a good opinion, that English naval architects have very much improved upon it. Mr. Reed has been assumed to be exclusively devoted to the broadside system, but by introducing these breastwork monitors he has ably initiated the attempt at once to secure fighting efficiency, lowness of free-board, and a turret armament, and, it may be hoped, effected more of real value than any of the thick-and-thin advocates of the turret system, if given wholly their own way.

In the engravings A represents the captain's cabin; B the bread room; C the ward room; D the spirit room and captain's stores; E the shot room; F engineers' stores; G cabins; H the engine room; J the ventilating shaft; K the pilot house; L the stoke hole; M cabins, bath rooms &c.; N N magazines and shell rooms; O berth for crew; P water and provisions; Q sick bay; R warrant officers' stores; S S S armour-plated skylights; T T T T engines for working the turrets; and U U the shaft tunnels. The plate engraving is drawn to a scale of $\frac{1}{16}$th of an inch to a foot; the wood engraving, which is a section through the centre of after-turret, to a rather larger scale.

## A NEW PYROTECHNIC COMBINATION.

Professor Nickels of the United States has found that if chloride of copper (commercial) be mixed with sulphide of carbon—the former in the solid state, we presume—some phosphorus having been previously dissolved in the sulphide of carbon, the mixture, although it smokes, does not inflame. If, however, in this state a few bubbles of ammoniacal gas be passed through the mixture, or if a little liquid ammonia be poured into it, the whole instantly bursts into flame. What a capital device this for theatrical use, where enchanters' cups or magic chalices are to present a foretaste of the *inferno* to the guilty lips about to quaff them!

We recently witnessed at the Grand Opera at Paris one of the most elegant and effective stage applications we have ever beheld, of a very beautiful and not common-lecture experiment in physical optics combined with pyrotechnics.

In the well-known scene in the opera of "Faust," when Mephistopheles taps the great wine vat in Auerbach's cellar—and, as usually performed, in place of wine coming forth a squib begins to sputter and sparkle—a thick column of real water issued from the cask and appeared upon the slightly darkened stage as a parabolic jet or column of wine-coloured liquid fire, like fluid cast-iron tapped from a cupola, and fell bubbling and splashing into a great open wine-tub. Into this the students and people around began to dip and fill their cups, but no sooner had the apparent red-hot wine reached the mid-depth of the tub than it all seemed to burst into flame, just as they attempted to dip out of it, and the whole became a cauldron of fire and white ascending smoke: the effect was as striking and terrible as it was new.

Those who have attended Dr. Tyndall's lectures on "Light" at the Royal Institution will have seen him perform an experiment (of Jamin's, if we mistake not,) which is the key to this. If, in a cylindrical vessel maintained full of water, a lateral adjutage be made, so that a spouting column issuing nearly horizontally falls in a parabola into a tub some feet below, and if at the opposite side of the vessel to the adjutage a glazed aperture be formed, so that a parallel beam from the electric light can be directed through or across the water in the cylindric vessel, and entering the water also of the jet as it issues from the same, the light will be reflected from point to point downwards in successive lines parallel to tangents to the bounding surfaces of the jet, *i.e.* from the bounding surfaces of the denser medium. The light is thus, as it were, conducted along the jet in its own curve, and the whole jet becomes luminous, as does every drop that sparkles and breaks from it on falling. If the glass diaphragm behind the adjutage be colourless, the falling jet column appears of yellowish or nearly colourless light, but if that diaphragm be of orange-red glass, so as to colour the light transmitted into the jet, the latter appears as perfectly like molten cast-iron as anything can be.

This was the method employed upon the stage at the Opera upon a grand scale, the jet being about 2½ inches diameter.

The fireworks in the tub were most probably ignited by the help of pellets of potassium included in them and arranged round the interior of the tub, so that as the water reached these they ignited, on principles well known. How is it that those who direct the pyrotechnics at the Crystal Palace have never discerned the wonderful effects that might be produced by such *internal* and coloured illumination as this of the huge jets of the great fountains—one or all? it could be done at a very moderate expense. On a smaller scale it was done twenty years ago with the central fountain at the Alhambra in Leicester Square, when that was first established as a scientific exhibition under the charge of the late Mr. E. Clarke. The internal illumination there of the jet of 50 feet in height in the darkened building, changing successively to all the colours of the spectrum, formed the most striking and popular exhibition of the grand philosophical toy-shop, which unfortunately did not pay as well as ballets and comic songs do there now. The Crystal Palace, however, presents facilities for a similar exhibition unique in its grandeur and beauty anywhere else in the world. We wish the directors would take our hint.

## THE AMERICAN POSITIVE-MOTION POWER-LOOM.

THERE has recently been published in an American contemporary (the *Artisan*) an illustrated description of a positive-motion power-loom invented in America a short time since and patented in that and most European countries. It is to the above-named journal that we are indebted for the particulars of the invention.

Fig. 1.

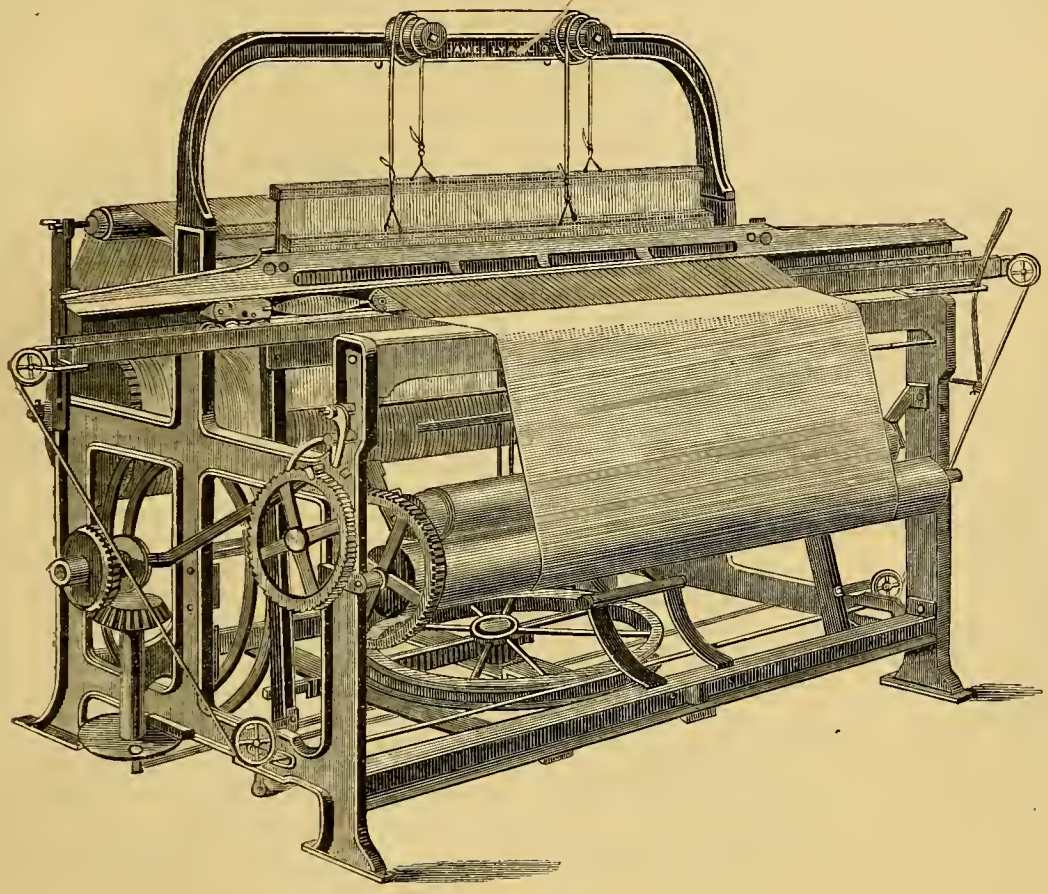
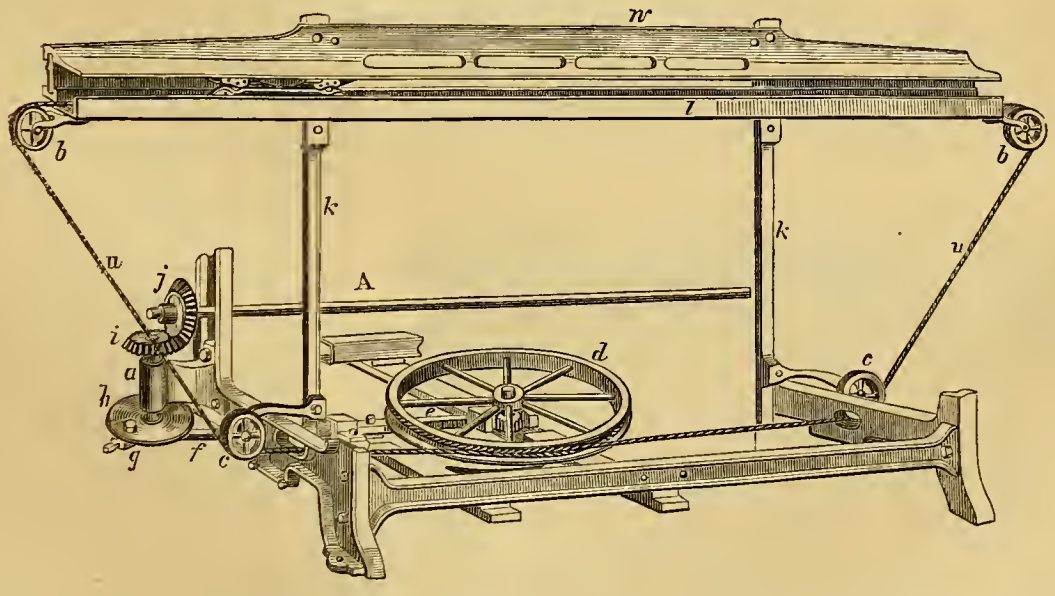


Fig. 2.

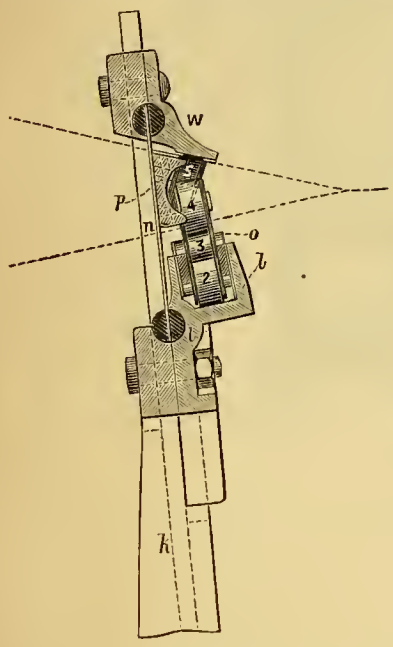



The shuttle of a loom has heretofore, as is well known, been actuated by pickers, which consist of pieces of raw hide, attached to picker-sticks which have had a hammer-like motion given to them for the purpose of driving the shuttle through the warp, from one side to the other alternately. The shuttle-motion has always been considered the least perfect part of the loom, most of the breakages and stoppages which occurred in the operation of the loom having resulted from the action of the shuttle, or originated in the shuttle-motion. In weaving heavy goods—as sail duck for instance—the cost of repairs and loss by the delay incurred in making them have been enormous. For many kinds of weaving,

owing mainly to these difficulties, the power-loom has never, or only to a very limited extent, been used. Among these we may mention the weaving of extra-wide goods, such as floor cloths and druggets, and the weaving of dress silks.

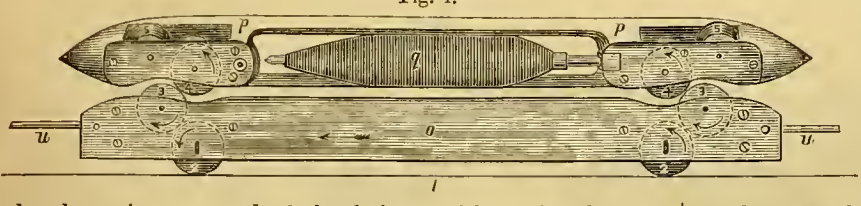
The object of the present invention is to obviate the difficulties attendant upon the use of the fly-shuttle in power-looms, and to render the power-loom applicable to all kinds of weaving. The invention will be clearly understood on reference to the accompanying engravings, in which fig. 1 represents the loom complete; fig. 2 all the mechanism of the positive shuttle-motion—the parts not necessary to illustrate this being omitted; fig. 3 is a front view of the shuttle and its driver; fig. 4 represents, in transverse section, the lay-reed and race-way with the shuttle and its carriage; and fig. 5 illustrates the action of the shuttle-carriage and shuttle upon and in the warp. In figs. 3 and 4 it will be seen that the shuttle, *p*, is furnished with two rollers 4, which are supported—the lower part of the shed of the warp intervening while the shuttle passes through the shed—upon two rollers 3, in the carriage. The carriage has two lower rollers 2, which run upon the bottom of the lower rail of the race-way, and the shuttle has two upper rollers 5, which run against the bevelled under side of the upper rail, *w*, of the race-way, which keeps the shuttle in place in front of the reed, *n*.

Fig. 3.




The lay is carried by the swords *k*, in the usual manner, and the movement may be produced either by a crank motion or by a cam; but the inventor prefers the cam, as it enables the movements of the lay and shuttle to be better timed. In fig. 2 the shuttle-carriage is shown connected at each end with a band *u*, which passes over rollers *b*, at each end of the lay; thence downward and under two rollers *c*, attached to the lower parts of the swords, and around a horizontal pulley *d*, near the floor. Attached to this horizontal pulley is a pinion, which gears with a horizontal sliding rack *e*, which receives a reciprocating motion through a connecting rod *f*, from a crank-wrist *g*, carried by a disk *h*, on the lower end of a vertical shaft working in a stationary box *a*, attached to the outside of the loom framing. On the upper end of the vertical shaft there is a bevel-gear *i*, gearing with and deriving motion from

Fig. 4.




a bevel-gear *j*, on one end of the shaft A, which carries the cams for operating the lay and those for producing the harness-motion. The reciprocating motion given to the rack *e*, by the bevel-gearing *j i*, vertical shaft crank-wrist *g*, and connecting rod *f*, produces, by its action on the pinion, an alternate or reciprocating rotary motion of the pulley *d*, which, by alternately winding and unwinding the band *u*, on opposite sides, causes the band to move the shuttle-carriage backwards and forwards along the lay and under the warp, thereby causing the carriage to carry the shuttle backwards and forwards through the open shed of the warp.

One important feature of the motion is that the carriage carries the shuttle over the intervening lower shed of the warp without the friction which is produced by the fly-shuttle, and which tends to break the warp. The manner in which this is effected is illustrated in fig. 5. The carriage has not even the slightest tendency to produce any lateral displacement of the warp yarns. The lower rollers 2, of the carriage are caused to derive a rotary motion, like that of the wheels of a road carriage, in their passage along the bottom of the race-way, and this motion is imparted, by contact, to the upper rollers, 3, in the opposite direction, as indicated by the arrows on the rollers in fig. 5. The shuttle is supposed in this

Fig. 5.

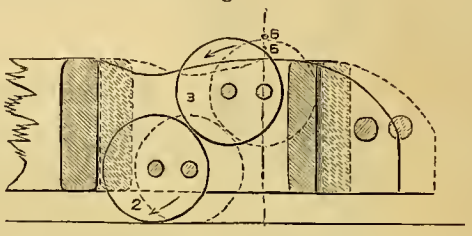



figure to be moving to the right. The dots 6, represent one of the threads of the warp yarn in two positions. The roller 3, of the carrier first strikes the yarn in the lower position; and as it moves along with the carriage, the latter moving to the right, the upper part of the roller 3, in contact with the yarn moves just as fast to the left, and so does not tend to carry the warp with it, but merely lifts up the latter to the higher position. The rotary motion of the rollers 3, is transmitted through the warp to the lower rollers 4, of the shuttle as the threads of the warp are successively passed between the rollers 3 and 4, with a scarcely perceptible rolling but no rubbing motion.

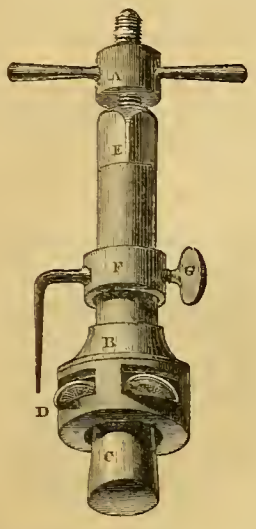
In the above-described operation, the shuttle being acted upon and controlled by a direct and continuous connection with the motive power, its action is absolutely positive, and is produced with very little power, and without any sudden jerk. The crank-wrist *g*, is so arranged as to gradually overcome the inertia of the shuttle at starting from one side or the other of the loom, producing an accelerated motion as far as the centre of the lay, and afterwards a gradually slower movement—gradually checking the momentum of the shuttle as it approaches the other side. One great advantage derived from this is that the weft is not subject to sudden pulls in starting, and another is that the shuttle does not rebound, and a tight and even selvedge is sure to be produced. Another advantage of the positive shuttle-motion is that it enables goods of any width to be woven. It is as easy for this motion to carry the shuttle through the widest as through the narrowest warp, and so it enables the widest goods to be produced at the same cost per square yard as the narrowest.

It is not, however, in weaving wide goods alone that the advantage of the positive shuttle-motion consists, but it enables dress silks, and other fine fabrics, which have hitherto been very little woven by power, to be produced without the necessity for the skilled labour which is requisite in weaving these goods by hand, and so promises to enable such goods to be woven in America, and thus to add to the list of American manufactures. Sixty of the looms are now in operation in New York, Paterson, N. J., and Hartford, Conn., running on fine dress silks, which are pronounced by judges to be at least equal to the celebrated hand-made Lyons silks. These looms run at from 110 to 120 picks per minute.

Many of the leading loom-makers in America have already taken licenses to construct these looms; fifty are now building by the Positive-motion Loom Company, the owners of the patent, for the Planet Mills of Brooklyn, N. Y., where there are now eight in operation, weaving drugget carpeting eighteen feet wide. One of these looms, with the attendance of one girl, produces an average of 150 square yards daily, which is equal to the production of five hand-looms requiring the attendance of ten men.

## THOMSON'S TUBE-CUTTER.

At page 8 of the present volume is an article "On Methods and Tools used for Fixing Tubes." We described, amongst other things, the excellent tube-cutters manufactured by Mr. Thomson, of Glasgow. Since that article was written, Mr. Thomson has altered the tool so as to obtain in it a greater number of cutting points. The accompanying engraving shows the cutter as now arranged. The enlarged part of the body B is formed with three vertical openings, holding the carriages in which the cutting-dies are held; and as the cone C is pulled upwards, the cutters are forced to any required distance from the axis, according to the diameter of the tube to be cut. The position of the cone is regulated by the hand nut A, and the tool is rotated by applying a spanner to the square neck E. A guide F is carried upon the body of the tool, and provided with a finger D; the use being to regulate the depth to which the tool is placed inside the tube to be cut, by bearing against the tube-plate to which it is held. The position of the guide relatively with the cutting-dies is fixed by the set screw G.




V. D.

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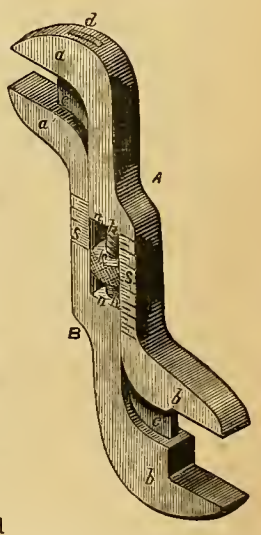
## RECENT PATENTS.

### WRENCHES.

George Miles Wells, *Barnsbury, London.—Patent dated December* 31, 1869.

This invention relates to that class of wrenches known as S-wrenches, having jaws at right angles to the shank. Owing to the peculiar form of such wrenches their jaws have heretofore been fixed and adapted to grasp only one size of nuts. The object the present patentee has in view is to render the jaws adjustable, so as to fit different sizes at the same time, avoiding the clumsiness and unwieldy nature of the ordinary adjustable hammer and other wrenches, and preserving the proportions which give to the ordinary non-adjustable S-wrench its value in so many instances. The invention may be stated to consist, first, in an adjustable S-wrench, composed of two parts, mortised and tenoned together in the manner hereinafter described, the mortise being formed in the exterior, and the tenon in the interior jaw of each part. Second, in combining with the two mortised and tenoned parts of the S-wrench, a right and left-hand screw and thumb-piece to operate it, thereby contracting or extending the jaws much more speedily than when a single screw is employed. Third, in the construction and combination of the two parts composing the S-wrench, each being provided with a tenon and mortise, arranged on opposite ends, so that the plane of movement of the two parts shall be in the direction of the length of the wrench, and at right angles or transversely to the jaws. Fourth, in the combination, in an adjustable S-wrench of scales upon the shank with the right and left-hand screw and thumb-piece, so that the wrench may serve the purpose of callipers for measuring iron or nuts; and lastly, in certain minor features of construction.

The accompanying engraving is a perspective view of the improved wrench, opened. The part A is provided at one end with an exterior jaw *a*, and upon the other with an interior jaw *b*, the two jaws being turned in opposite directions, as usual in S-wrenches. The part B is provided in like manner at one end with the interior jaw *a′*, and at the other with the exterior jaw *b′*; these jaws, when the parts are placed together, forming, in conjunction with the jaws *a b*, the two sets of jaws with which the wrenches should be provided. Each interior jaw *a′ b* carries a tenon *c*, which fits in a mortise *d* cut in each exterior jaw *a b′*. The contiguous sides of the shank portion of the two parts A B fit together, when the parts are properly adjusted, so as to admit of their sliding longitudinally, in order to open and close the jaws, which stand at right angles to the plane of movement. The arrangement of tenons upon the interior jaws and mortises in the exterior jaws, enables great strength and solidity to be imparted to the jaws, at the same time retaining perfectly the S shape of the wrench; but, if desired, the position of the parts may be reversed, though not with as good results. It will be noticed that the mortises and tenons are formed upon that side of the division line between the two parts of the divided shank nearest their respective jaws, so that, without increasing the size or amount of metal in the jaws, their strength can be preserved while projecting them out from the shank, and giving them that "bill shape" which is requisite in an S-wrench.




For the purpose of adapting the wrench to very small nuts as well as to those of large size, the patentee so constructs and arranges the jaws that, when the smaller pair *a a′* are entirely closed, the larger pair *b b′* will be opened to the maximum extent to which the smaller pair can be extended and used. And thus the smaller pair can be employed for sizes less than the minimum opening of the larger jaw; the latter, on the other hand, being capable of grasping nuts and like articles which cannot be contained between the former. When the two parts A B are placed together, they may be actuated to contract or expand the openings between the jaws by a pall and ratchet worm and rack, or other well-known devices. The patentee prefers, however, to employ a right and left-hand screw *h*, provided with a milled head or thumb-piece *k*, located midway between its two ends.

In order to provide a place in the wrench in which this device may be held, so as to be conveniently situate with respect to the hand of the operator, and at the same time entirely out of the way, he forms in the interior edge of each part A B a recess *m*, terminating in a shoulder *n*, the recess in the one part being formed so as to extend in the direction opposite to that of the recess in the other part, so that when the two are placed together the thumb-piece *k* and exposed parts of the screw will be enclosed by the shoulders or end *n* and the sides *m* of the recesses. In the one shoulder *n*, a screw-threaded socket is tapped, for receiving the end of the screw carrying the right-hand thread, and in the other shoulder a like socket receives the left-hand screw threaded end of the screw *h*. The thumb-piece *k*, situate between the two, will lie between the space enclosed by the four sides *n m*. By turning the thumb-piece it will be seen that the jaws, owing to the employment of the right and left-hand screw, will move apart with twice the

speed which could be obtained by the employment of either a right-hand or left-hand screw, and by this means a great advantage over ordinary wrenches is attained.

Again, by reason of the formation of the recesses *m*, and the employment of the right and left-hand screw in this manner, the wrench is made to serve also the purpose of callipers; a graduated scale S being formed on the edge of each recess. And by this means the size of any bolt, or nut, or iron can be determined with the greatest facility, and without the employment of a separate instrument.

It will be perceived that this method of dividing the wrench into two parts, whose line of movement in parallel planes is in the direction of their length, is especially applicable to S-wrenches, in which the jaws stand at right angles to the shank, and not to what are known as "diagonal wrenches." The construction and arrangement of parts is such as to secure the greatest strength and solidity, at the same time preserving perfectly for all practical purposes the form of the non-adjustable S-wrench, and thus adapting the instrument to many uses for which the ordinary adjustable hammer-wrenches are entirely unfitted. The adjustment of the implement can readily be effected with one hand alone, the shank being held in the hand, and the roughened or milled head K pressed upon and rolled over a board, or other suitable surface. The arrangement of the adjusting-screw and head is such that, practically, the wrench has the same unbroken surface as the ordinary S-wrench.

## PURIFYING AND STORING WATER.

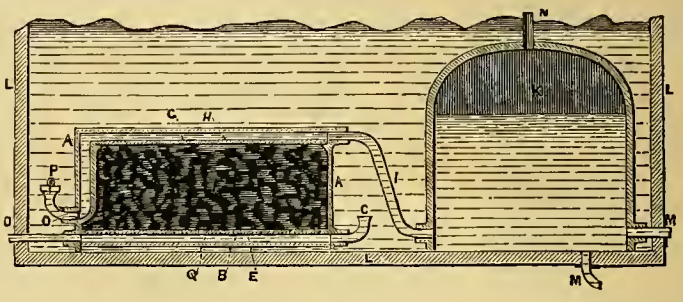
FREDERICK LIPSCOMBE, Strand, London.—*Patent dated January* 20, 1869.

THIS invention relates to that system of filtering wherein a filter is placed or formed inside a cistern, or other vessel constructed to hold water, the impure water passing through the filtering media, whence it flows in a purified condition to any convenient part or parts of a house or building.

According to this invention, the patentee constructs a chamber in the lower part of the filter, through which chamber, by means of an aperture, the unfiltered water flows, finding an exit through another aperture, to any convenient part or parts of the house or building when necessary. The top side of the said chamber is perforated with holes, through which the unfiltered water in the chamber flows upwards through the filtering media, which is composed of animal or vegetable charcoal, plates of porous stone, or any of the usual filtering media separately, or in combination, whence the purified water is drawn off, either directly through one or more pipes leading to the outside of the cistern; or the purified water, after leaving the filter, is allowed to flow into a pure water reservoir placed or formed in the cistern, whence it is drawn off as required. This reservoir, which may be fitted with an air-pipe, is kept in position either by being weighted, or, by the more preferable plan, of leaving its under side wholly or partly open, and then cementing it all round to the bottom of the cistern.

In order to cleanse the filter, the patentee closes the aperture in the chamber through which the unfiltered water enters, and opens an aperture in the upper part of the filter (which aperture had previously been closed), so that the unfiltered water may enter the filter through the before-mentioned upper aperture, and flow downwards through the filtering media, and into the chamber of the filter, whence it passes off through the pipe or pipes which draw the unfiltered water from the cistern. By this arrangement, the impurities which may have lodged inside the filter are driven out. When the filter has been sufficiently cleansed, the upper aperture of the filter is closed, as before, and the aperture in the lower chamber of the filter re-opened. In ordinary cases, where the amount of purified water is moderate, one pure water reservoir only in connection with one filter is sufficient; but where large quantities of purified water are wanted, then one or more additional filters may be connected with the reservoir, so as to obtain a quicker supply; and, instead of one reservoir, several may be employed, but one is generally sufficient. All the filters may be cleaned together in the manner before described, or a few at a time, or each separately.

The annexed engraving represents a vertical section of the improved filter, in connection with an open-mouthed reservoir for pure water, both contained within an ordinary house cistern. The filter A is provided with a chamber B at its lower part, through which, by means of an aperture C, the unfiltered water flows from the cistern in which the filter is placed, driving out any impurities which may have lodged there, and finding an exit through another aperture D, whence it flows, or is drawn off, to any convenient part or parts of a house or building. The top side E of the chamber B is perforated with holes, or is constructed of any material or combination of materials that will




allow water to pass through it, through which the impure water in the chamber B flows upwards through the filtering media in the chamber or space F, such media being composed of animal or vegetable charcoal, plates of porous stone, or any filtering media, separately or in combination. The purified water passes up through the perforated or porous plate G into the top chamber H, whence it flows or is drawn off through one or more pipes I leading to the outside of the cistern. Or the purified water, after leaving the filter, flows into a pure-water reservoir K placed in the cistern L, whence it is drawn off, as required, through one or more pipes M M. This reservoir K is kept in position either by being weighted or otherwise secured, or by the more preferable plan of having its under side made wholly or partly open, and cementing, or otherwise making the same watertight all round the edge to the bottom of the cistern L. The reservoir K, where necessary, is fitted with an air-pipe N carried to a higher level than the water in the cistern. In order to cleanse the filter, the aperture C through which the unfiltered water enters may be closed by means of a cork or other plug, or by a valve or tap, or otherwise, and the aperture O leading to the upper part H of the filter opened; such aperture having previously remained closed by means of a moveable plug P, or by a tap, or otherwise, in order that the unfiltered water may enter the filter through the before-mentioned upper aperture O, and flow through the filtering media reversely to its ordinary course; then into the chamber B, and afterwards through one or more pipes D that draw from the cistern unfiltered water. By this arrangement the impurities which may have lodged inside the filter are driven out. When the filter has been sufficiently cleansed, the upper aperture O is closed, as before, and the aperture C in the lower chamber of the filter re-opened. When several filters are used, they may all be cleansed together in the manner before described, or a few at a time, or each separately. There may obviously be several modifications of these arrangements. For example, the aperture O leading to the upper part of the filter may be lower than the aperture C without any injurious effect. The lower plate or bottom Q of the filter may be dispensed with, and the rim of the bottom of the filter be cemented, or otherwise made watertight, or nearly so, round its lower edge to the bottom of the cistern.

## MANUFACTURE OF PILES, FAGOTS, OR BILLETS OF IRON OR STEEL.

JOHN HENRY JOHNSON, 47 *Lincoln's Inn Fields; a Communication from* GEORGE H. SELLERS, *Wilmington, Delaware, U.S.A.*—*Patent dated January* 29, 1869.

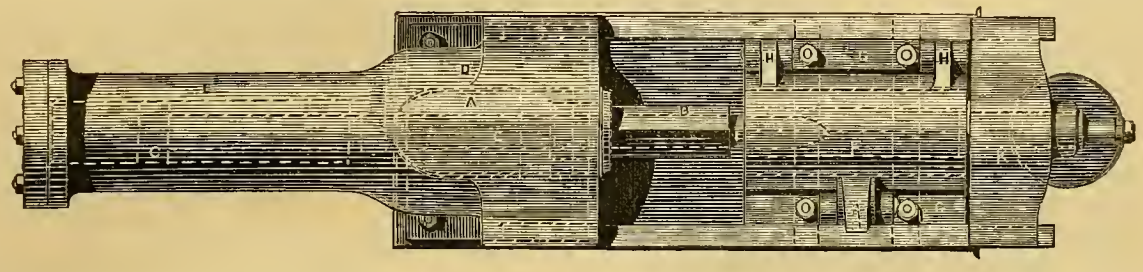
THIS invention relates to the making of piles, fagots, or billets of any desired shape, from which finished shapes or plain merchant

irons or steels can be rolled; also to the making of hollow piles or fagots of iron or steel, from which pipes or columns can be rolled. The essential feature of the invention consists in the forming of iron or steel into piles, fagots, or billets preparatory to rolling by pressing the metal into forms of the required shape; also in forming iron or steel into hollow piles or billets preparatory to rolling into hollow articles, such as pipes or columns. Various combinations or arrangements of machinery may be employed in manufacturing pressed and moulded piles or fagots as above described, but that which the inventor has found to give the best results up to this date consists of a hydraulic or other powerful press, the ram of which carries a plunger which accurately fits inside a strong metal case or mould of any desired size and transverse section, the sides of such mould being capable of opening on hinges in order to release the compressed and finished pile. The blooms having been placed in the mould, and the sides closed down and secured, the plunger is caused to enter through one end of the mould, which is left open for that purpose, and to forcibly compress by the action of the hydraulic press the metal contained inside the mould, thereby not only expelling the impurities which may be in the bloom, and which escape through the joints in the mould, but causing the metal to be thoroughly consolidated and to take the exact form of the mould. If a hollow pile, a punch or pointed mandril of the required size and section is fitted into the end of the plunger, and on entering the mould perforates the bloom or blooms and forces the metal laterally against the sides of the mould. The end of this punch passes through the opposite end of the mould, which has an opening in it just large enough to allow the punch to enter, and this opening is kept closed till the punch arrives by a sliding rod or stopper pressed forward by a counterweight. The punch having penetrated the metal in the mould the plunger then enters and compresses the metal in a longitudinal direction, after which the plunger and punch are withdrawn. By reversing the action of the press the mould is opened and the finished pile, fagot, or billet, either solid or hollow, as the case may be, is removed in a state ready for rolling.

Fig. 1 of the accompanying engravings is a plan, and fig. 2 a transverse section of this improved apparatus. A, fig. 1, represents the piston of a hydraulic steam screw or lever press, which carries a plunger B of the same shape as the section of the pile required. This plunger B is hollow, to allow the piston C to move through the same; the said piston passes through the cylinder D into another cylinder E lying behind and in the same plane as the cylinder D; the piston C is only used when hollow piles are to be made. The plunger B is of the same shape as the internal section of the opening formed by the dies F F F, which are held in place by the frame of the machine G G and by the hinges H H or other contrivances, which permit of the opening of the top form F, which, when open, allows the admission of a number of blooms of puddled iron direct from the puddling furnaces, or of blooms formed from puddled or other iron or steel which have been simultaneously brought up to a welding heat, and placed within these forms; the top being then closed and the power applied to the plunger B, the bulls or blooms will be forced into each other and into the shape of the mould formed by the closing of the dies against each other; the construction of these dies being such that they do not close so tightly as to prevent the expulsion of the impurities which may be in the blooms when placed within the dies.

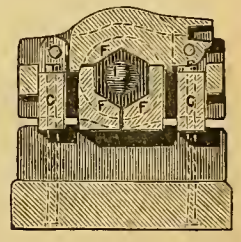
When it is desired to form a hollow pile, the piston C has a pointed punch I inserted in the end of the same, and the opposite end of the dies or forms has an opening left in the end stopping up the forms corresponding to the size of the punch I, which opening is stopped up with a counterweighted stopper K. This stopper is forced back when the punch I presses against it. The heated bloom being placed within the forms or dies, the piston C is moved forward, forcing the punch I through the metal, the rounded or pointed end of the punch causing the metal to be pressed aside rather than driven ahead; when this punch has passed through the metal and forced the stopper K back, the plunger B, being of the shape of the opening formed by the dies, is brought forward, thereby pressing the metal into the shape of the forms and solidifying it around the punch I.

Fig. 1.



When pressed up as far as required, the plunger or piston C is withdrawn by opening the escape valve and applying power to the other side of the points, thus with drawing the punch from the metal. When this is accomplished, the pressure is removed from the plunger B, the dies are opened, and the pile is removed, which consists of a hollow homogeneous mass devoid of seam or opening, into which cinder, scale, or dirt can be forced in the process of reheating.

Fig. 2.



The power applied in either solid or hollow piles should be in proportion to the size and solidity required for the pile or billet. By the removal or insertion of the punch I, either solid or hollow piles may be formed in the same machine.

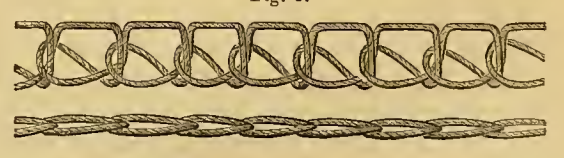
## LAW REPORTS.

SEWING MACHINES.—THE WILLCOX AND GIBBS SEWING MACHINE COMPANY *v.* WILLIAM STIRLING AND SONS.—Jury Trial.—First Division, before the Lord President, Edinburgh, July 21st, 22nd, and 23rd.

This was an action for an alleged infringement of a patent obtained by John Henry Johnson, of 47 Lincoln's Inn Fields, for "Improvements in Sewing Machines," being a communication from J. E. A. Gibbs, of Virginia, U.S.A. This patent is dated the 15th of July 1857, No. 1971, and was subsequently assigned to the pursuers. The alleged infringement consisted in the use by William Stirling and Sons, Turkey-red Dyers and Calico Printers in Glasgow, and at Cordale and Dalquharn, Renton, Dumbartonshire, of sewing machines made in contravention of the pursuers' patent, and supplied to them by J. Mellor, a machinist in Salford.

The Solicitor-General for Scotland, Mr. Shand, and Mr. Balfour (instructed by Messrs. Macnaughton and Finlay, W.S. of Edinburgh), appeared for the pursuers;

Fig. 1.



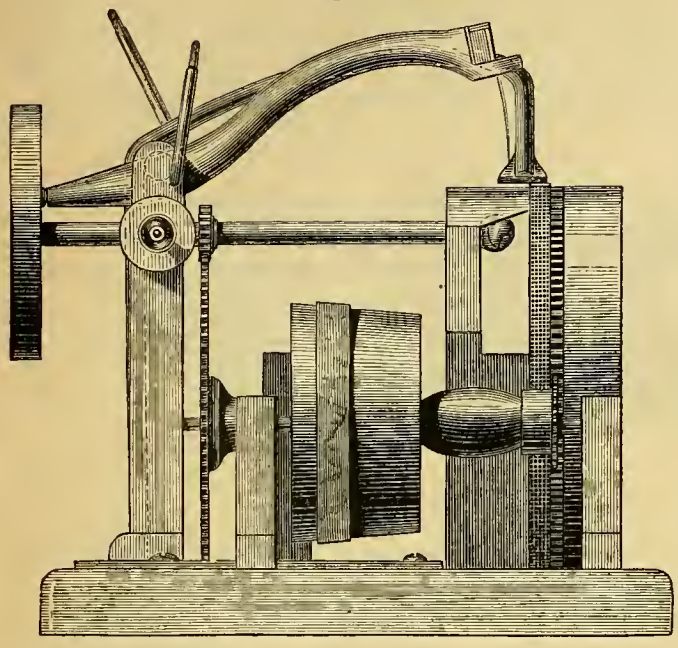
and Mr. Clark and Mr. Watson (instructed by Mr. James Webster, S.S.C.), for the defenders.

The invention of Mr. Gibbs relates to certain peculiar constructions and arrangements of sewing machines for uniting or ornamenting by stitches fabrics of all kinds.

According to one arrangement a single-thread chain or tambour stitch is produced by means of a needle and revolving hook, each loop of the stitch being

twisted half a revolution after it has been drawn through its predecessor, by which means a firmer and more secure chain stitch is obtained than has hitherto heen accomplished by sewing machines of this class. Fig. 1 is a diagram of the twisted chain stitch. The needle is jointed to a vibrating needle arm, shown in the side elevation (Fig. 2) of the original machine as represented in the specification, which is actuated by a cam. The shaft which carries the needle cam is fitted or formed

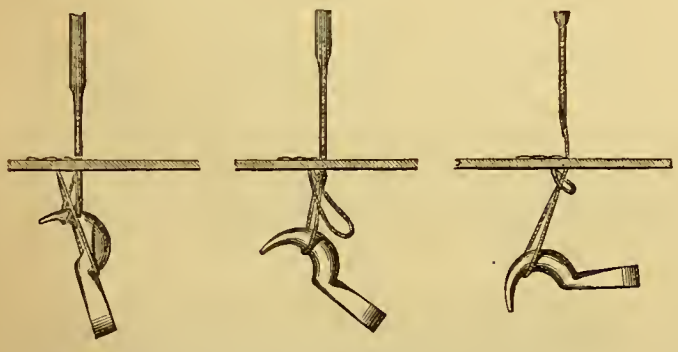
Fig. 2.



into a hook at its front end (sec Fig. 3), such hook being of a peculiar construction. It is gradnally increased in thickness from its point, which enters the needle loop towards its shank or shaft, and is concavely shaped at the part where the needle loop is in contact with it, for the purpose of not drawing more thread than is requisite. After the loop has thns been drawn open it will slip off the hook and lodge in an angular recess which the hook forms with the shaft. This is effected whilst the hook revolves from a horizontal to a vertical downward position, such motion giving a twist to the loop through the aid of a spur or "cast off" on the back of the hook. This "cast off" is so arranged in relation to the hook and angular recess, that the loop is spread for the nose of the hook to pass through it on taking a fresh loop from the needle. At this moment the hook has two loops engaged with it, the fresh loop at the point or nose and the preceding loop, which now bears against the convex part of the hook. Tbe further motion of the hook will allow the latter loop to slip off entirely from the hook, which loop is drawn tigbt by the opening or spreading of the new loop.

Motion is imparted to the machine by drawing the cloth which is to be sewn through it by hand. The cloth is pressed npon the roughened periphery of a revolving wheel, which carries a spur wbeel gearing into a pinion on a second shaft

Fig. 3.



This second shaft carries a conical drum, which imparts motion by means of a strap or belt to a second conical drum, thc shaft of which carries a spur wheel gearing into a pinion on the cam or revolving hook shaft. The strap or helt is adjnsted along the conical drums so as to vary the relative speeds of the shaft which works the actnal sewing mechanism and the feed shaft, and conseqnently regulate the size of stitch, since if the cloth is drawn through the machine faster or slower, in relation to tbe movements of the needle and hook, it follows that a greater or less length of cloth will be drawn along between each stitch. The joint in the head of the needle is to enable the needle to play laterally, and thns admit of the cloth being moved, even when the needle is still in it.

The specification comprises otber improvements in sewing machines for producing the lock-stitch by means of rotatory thread cases, and for enabling different varieties of stitches to be produced by the aid of a reversible feed in conjunction with a double pointed rotatory lenticular thread case; but these had no bearing on the question at issue, which was confined chiefly to the 2nd and 3rd only of eleven claiming clanses in Mr. Gibbs' specification, namely—

"The application and use of a revolving hook working in connection with a needle in the manner and for the purpose described and illustrated by the drawings;" and

"The twisting or turning of the loop when sewing with a single thread after snch loop has been passed through the cloth, and before taking a fresh loop, in the manner and for the purpose described and illustrated by the drawings."

Thc machines complained of, and which were employed by tbe defenders at their works, are almost identical in general construction and arrangement with those now largely sold by the Willcox and Gibbs Sewing Machine Company, and contain precisely the same combination of revolving hook and eye pointed needle for producing a twisted chain stitch as that described and claimed in Mr. Gibbs' specification.

The followiug are the issues:

"It being admitted that the said John Henry Johnson obtained the letters-patent No. 9 of process, dated the 15th day of July 1857, and sealed the 1st day of January 1858, and filed the specification and relative drawings attached thereto, of which No. 10 of process contains a certified copy:

Whether between the 1st day of January 1867, and the 5th day of January 1869, or during part of the said period, and during the currency of the said letters-patent, the defenders did, at their works at Cordale and Dalquharn, Renton, in the County of Dunbarton, wrongfully, and in contravention of the said letters-patent, use the invention described in the said letters-patent, specification, and relative drawings, to the loss, injury, and damage of the pursuers?

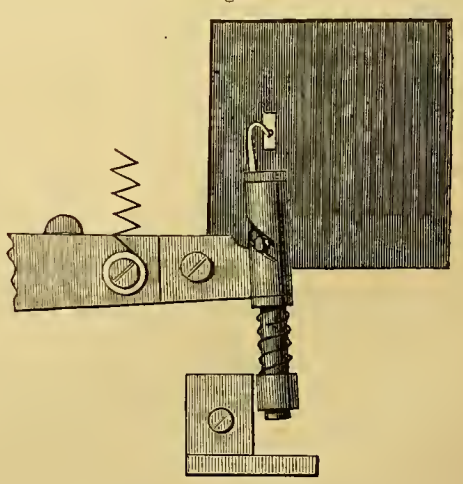
Damages laid at £1,000; or—

1. Whether the invention described in the final specification, filed 15th Jannary 1858, of which No. 10 of process contains a certified copy, is essentially different from the invention described in the provisional specification, lodged 15th July 1857, of which No. 10 of process contains a certified copy?
2. Whether the invention described in the said letters-patent and relative specification is not practically useful for the purposes therein set forth?
3. Whether the pursuers are not the true and first inventors of the invention described in the said letters-patent and relative specification?
4. Whether the invention described in the said letters-patent and specification was publicly used in Great Britain prior to the date of the said letters-patent?
5. Whether the description contained in the said specification is not such as to enable workmen of ordinary skill to practise the said invention, so as to produce the effects set forth in the said letters-patent and specification?"

The specifications relied upon by the defenders as prior publications of Mr. Gibbs' invention were as follows:—Watson, 2384, A.D. 1856; W. H. Johnson, 966, A.D. 1853; Kidd, 2544, A.D. 1855; J. H. Johnson, 1133, A.D. 1857; Hughes, 1431, A.D. 1854; Whittaker, 2355, A.D. 1855.

Mr. Shand opened the case for the pursuers and, after referring to the various kinds of single and double-thread sewing-machines suggested prior to the date of Mr. Gibbs' patent, and the disadvantage attendant upon the use of a reciprocating looper in single-thread sewing-machines, he described tbe leading features of

Fig. 4.



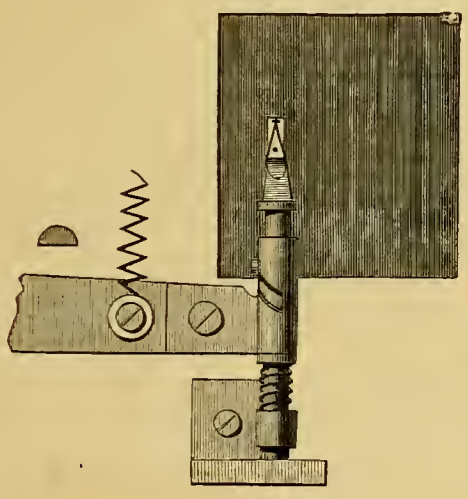
Mr. Gibbs' invention. It was contended on behalf of the pursuers that the continuous rotatory hook in the defenders' machine constituted the essential feature of Mr. Gibbs' invention, that such hook was of great utility, and entirely novel at the date of the patent, and that the specification and drawings were amply sufficient to enable a workman of ordinary ability to carry out the invention.

The main points for the defenders rested chiefly upon the alleged prior publication in Watson's specification of a rotatory hook producing a twisted chain stitch, upon the want of utility of Mr. Gibbs' invention as specified, and upon the insufficiency of the pursuers' specification. All the alleged prior publications, with the exception of Watson's specification, were abandoned, one by one, as the trial proceeded. The pursuers maintained that Watson's hook, of which we give two plan

views at figures 4 and 5, showing it in different positions, was not a continuous rotatory hook but a hook having a combined circnlar and longitndinal reciprocating motion. The following is Watson's own description extracted from his specification:—

"My invention consists, firstly, in an improvement in the method of constructing and operating the hook which takes up the loops formed beneath the table in single-thread sewing-machines; and secondly, in an improved feed motion. There has always been great uncertainty in the operation of that part of a single-thread sewing-machine which is to take off the loop and retain it until the needle shall have passed through in the succeeding stitch, and almost all of the various plans, such as hooks, loopers &c. proposed, have been designed to remedy that uncertainty. This is also the principal object sought to be accomplished by this part of my invention, which is designed to make the workings of the loop-forming part as positive as the operations of the needle itself. The difficnlty grows out of the fact that the thread mnst be released and taken up at each and every stitch. Now, as the time allowed is very short, and the space to work in is also extremely limited, the slightest irregularity is sufficient to canse the hook looper, or whatever device msy be employed, either to miss the thread altogether, or else to cause the needle to pass by without going through, and thus in either case the stitch will not be formed; in fact, the needle more commonly misses to pass through the loop than the hook or looper fails of taking hold of the thread, because even after the hook or looper gets hold of the thread it is commonly held in snch a bad position that the point of the needle is as likely to pass outside as to go tbrongb. My improvement possesses peculiar advantages in this respect, for it seizes the thread while in contact with the side of the needle, draws it away, and opens it into a wide loop directly in the path of the needle at its next stroke (see fig. 5). In performing this the hook takes three different positions. In the first position, it is at the side of the needle, with its point jnst back of the thread (see fig. 4); in the

Fig. 5.



second, it has moved horizontally, thus taking hold of the thread and pulling it off to one side; in the third, the hook turns one quarter round, thereby twisting the loop from a vertical to a horizontal position, forming a comparatively large opening directly in the path of the needle (see fig. 5), thereby insuring its entrance in the most certain manner."

The first witness examined was Mr. J. E. A. Gibbs, of New York, who deposed that he was engaged upon the invention abont eighteen months before the patent was taken out, that there never was any revolving looper nsed for interlacing the loops of a single thread for the purpose of sewing prior to his invention. He was acqnainted with the specification of Watson, bnt had not seen it at the time of his invention, and had no knowledge of it. He became acquainted with the machine manufactured under Watson's patent in May or June 1857. His machine was a complete failure as far as snccess in the market was concerned. He never imagined that Watson's hook had any possible connection with his invention, or any resemblance whatever to it; that in Mr. Gibbs' machine the hook revolves continuonaly, turning ronnd within the loop, passing the loop over the looper and off at the back of the looper, in the meantime drawing another loop throngh the former loop; that at the moment it is taking up a new loop the former loop is on the back of it; that the loops are interlaced by the revolution of the looper, thus performing three fnnctions—taking the loop from the side of the needle, apreading and twisting it, and drawing the second loop through the first, interlacing the stitches continuously with each other; that the Watson hook takes the loop from the aide of the needle, drawa it away horizontally from the line of the needle, and gives it a quarter-twist for the purpose of spreading it across the path of the needle; the needle then passes down through the loop thus formed and held by the hook; the hook then retreats backwards out of the loop, the loop passing off at the same point where the hook entered it; the hook then takes another loop from the needle, as before.

That the difference in this operation is, that while Mr. Gibbs' hook interlaces the two loops by its own action, Watson's hook does not interlace the loops at all, but only holds them in a position for the needle to interlace them; that the Watson hook only gives the loop one qnarter-twist, while Gibbs' hook gives it a half-twist; that Mr. Watson's hook draws the loop horizontally away from the line of the needle before giving it the twist, whilst the Gibbs hook holds it in a line perpendicular with the line of the needle. In the Gibbe machine the twist goes through the body of the material and adds greatly to the strength of the sewing; in Watson's the loops cross each other in the surface, and the thread is liable to be rubbed off and broken. Another and more important difference is that the cross caused by the twist coming within the body of the material is parallel with the surface, so that it forms a bight which holds, while in Watson's, the cross being on the surface, there is comparatively no bight; that Watson's machines were manufactnred for not more than about one year, while the sale of the Willcox & Gibbs machine has been increasing rapidly every year, and now amounts to about 20,000 machines per annum; that there is no difference between the defenders' machine and the machines which the Willcox & Gibbs Sewing Machine Company have been making under their patent, except that the workmanship of theirs is better; that the defenders' is an exact copy of the Gibbs hook as described in the specification, and works in connection with the needle in exactly the same manner.

Mr. Alexander, principal mechanical assistant to Mr. J. Henry Johnson, of 47 Lincoln's Inn Fields, proved that for about ten years he had given special attention to sewing machines, and had written a good deal upon the subject; that he had examined all the specifications relating to sewing machines, and had known the Willcox and Gibbs machine from its infancy; that he prepared the pursuers' specification, which describes an invention altogether novel and original; that, so far as the actnal sewing mechanism is concerned of the defenders' machine there is no difference betweeu it and the mechanism of Messrs. Willcox & Gibbs'; that prior to the date of Mr. Gibbs' patent, single-thread sewing machines did not work with a continuous rotatory looper in the form of a hook like Mr. Gibbs' hook; that, in his opinion, the continuous rotatory hook of Mr. Gibbs was one of the most beautiful discoveries made in the sewing machine, and that it had undoubtedly proved perfectly successful; that there is no resemblance whatever between Watson's machine and the pursuers'; that the twisting of the loop in Watson's machine is for a different purpose from that contemplated in Mr. Gibbs' invention; that it is not produced by the same mechanical appliances at all, and that it was not so efficacious a twist for the purpose of giving firmness to the sewing, because the one side of the loop that is produced under the cloth is twisted over the other at a point on the under-face of the cloth itself midway between the two ends of the stitch, the crossing of the threads being therefore on the face of the cloth, which leaves a slight ridge formed by one thread lying over the other, which would inevitably cause the thread to wear or to cut sooner than if it lay below; that there would also be no particular hold or bight on the thread, from the fact that there is no particular pressure of the one thread upon the other when in that position.

Mr. Fothergill, consulting engineer, proved that he was generally acquainted, as an engineer and machinist, with the sewing machines which were in use previous to Mr. Gibbs' patent of 1857. In his opinion that patent embraced an important invention. He considered that the new arrangements and combinations introduced by it gave a new character to the sewing machine, making it more efficient. The rotatory hook, or looper, from its shape, arrangement, and adaptation was a feature of a most extraordinary character, and gave quite a new character to the successful action of the machine itself. He considered it to be quite a novelty in itself, in respect of its shape, adaptation, and action; that Mr. Gibbs' patent insured not only more accurate working, but also the constant working of a machine at a higher velocity, producing more work, better in quality, and better in appearance to the eye; that he did not consider Watson's machine was an anticipation of Mr. Gibbs' invention; that the whole of the arrangements described in the specification are such as that a man of ordinary skill in sewing machines would have no difficulty in carrying them into practical operation from the description given.

Mr. E. Burns, a mechanical engineer of Manchester, who had given considerable attention to the construction of sewing machines, and Mr. G. H. Slight, a machine-maker, of Edinburgh, both gave evidence confirming the statements of Mr. Alexander and Mr. Fothergill.

Evidence was also given as to the practical utility of the Willcox and Gibbs machine by Mr. Alexr. Wight, formerly a partner in the firm of Hengh, Balfour, & Co., the extensive manufacturers of Arnold's ruffles. Also by Miss C. Wilson, the forewoman to the above-mentioned firm, who spoke to the certainty and rapidity of action of the Willcox and Gibbs machine, of which over 100 were then in use at Messrs. Hengh, Balfour, & Co.'s manufactory. After examining Mr. James Willcox, one of the pursuers, as to the extensive demand for the pursuers' machines, the case for the pursuers closed.

The defenders called six witnesses, including Prof. Rankine, of Glasgow University, to prove the insufficiency of the pursuers' specification, and the want of novelty of Mr. Gibbs' invention; after which the Solicitor-General and Mr. Clark addressed the jury for their respective clients, and the Lord-President summed up at considerable length. The jury retired to consider their verdict, which, after nearly half an hour's consideration, they found for the pursuers on all the issues, with £28 damages; being equivalent to £4 on each of the seven machines employed by the defenders.

E. P. A.

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Sewing Machines.—Willcox and Gibbs Sewing Machine Company *v.* Bell.—Before Vice-Chancellor Sir W. M. James, August 20th. This was a motion by the Willcox and Gibbs Sewing Machine Company of New York and London, to restrain the defendant, who carries on business as a dealer in sewing machines in Falcon Square, London, from infringing letters patent granted to J. H. Johnson, dated 15th July 1857—No. 1971, for improvements in sewing machines; a communication from Mr. J. E. A. Gibbs, of Virginia, U.S.A.

The Bill was filed August 12th, 1869, and an ex-parte application for an injunction made to the Vice-Chancellor, upon which he granted the injunction to the 21st August, directing the defendant to be served with the bill and notice of motion to be given for a sitting before the Vice-Chancellor for the 20th of August.

The bill and notice of motion were accordingly served on defendant on the 16th August, and copies of the affidavits were furnished to defendant's solicitors the

following day. The plaintiffs, having no overtures from the defendant, then proceeded to file further affidavits of scientific witnesses, and made application for the affidavita in reply. The defendant, however, filed no affidavit until the 19th Angnst, when he filed an affidavit to the effect that he had had no notice prior to the bill being filed, and also setting out that he had only sold one of the infringing machines, and that if notice had been given him he would have admitted the infringement, and would have paid the plaintiffs, as damages, the profit he had made by the sale of the one machine.

The affidavits of the plaintiffs proved enjoyment of the patent for the whole term of it, that injunctions or orders establishing the patent had beeu made in eight different suits in the Court of Chancery in England, and that the plaintiffs had also recently obtained a verdict in their favour upon the patent in the Court of Session in Scotland.

Mr. Theodore Aston, instructed by Mr. J. Henry Johnson, of 47 Lincoln's Inn Fields, appeared for the plaintiffs; and Mr. Graham Hastings, instructed by Messrs. Lawrence, Plews & Co., appeared for the defendant.

After hearing connsel on both sides, the defendant contending that he ought not to pay the costs of the suit, but submitting to have the motion treated as the hearing, the Vice-Chancellor ordered a perpetual injunction, as prayed for by plaintiffs. The defendant was also ordered to give up the only infringing machine under his control, and to pay the plaintiffs the price of the machine purchased by them, and to pay plaintiffs their costs of suit.

We report this case for the purpose of showing that the courts do not hold a defendant in a suit of this kind to be entitled to any notice prior to filing the bill, and that if a defendant really does not intend to contest the validity of a patent, he should at once give the plaintiffs notice to that effect, and of his willingness to pay reasonable damages, as this only will place him in a position to save additional costs, which must be incurred if the plaintiff has no intimation of this kind. The cases of Burgess *v.* Hills, and Burgess *v.* Hateley, 26 Beavan, are quite clear on this point.

## REVIEWS OF NEW BOOKS.

### FOREIGN LITERATURE.

*Lehrbuch der Mineralien und Felsartenkunde.* Von Dr. F. Senft. 1 vol. 8vo. 2 plates, Jena, 1869.

This is an elaborate system of mineralogy and petrology. The well-known reputation of Doctor Ferdinand Senft, who is Professor of Physical Philosophy at the Grand Ducal Gymnasium of Eisenach, and holds other important appointments, is a sufficient guarantee for its accuracy and scope. We must confess, however, that it seems to us to view its subject from a too rigidly classified, and little practical or applicable point; and from the want of *habitats* being generally given for the rocks and minerals of which they are built up, the work loses much of its value for general study or reference, however valuable it may be as a class book, to accompany a comprehensive course of lectures, which would seem to have been its primary intent.

*Zeitschrift für das Berghütten und Salinenwesen in dem Preussischen Staate.* Small 4to., Ernst & Korn, Berlin, 1869, with plates.

The first part of the 17th vol. of this work has reached us. It co-ordinates in Prussia with the "Annales des Mines" in France, being published under the direct auspices and authority of the Minister of Trade, Works, and Mines, at present the Graf von Itzenplitz. It is, however, we are obliged to say, a long way behind the corresponding French work in the able style and character of its articles. It is well illustrated with lithographic plates and woodcuts; but the price (13s. 6d. in England) is greatly too high for what remains, after the long list of the immense *personnel* of the Prussian State mining establishment has been turned over. This catalogue of the *Königlich Preussischen Bergwerks-Verwaltung* for the 15th April 1869, extends to twelve of these close printed pages, and proves either that our British corresponding personal official apparatus, so far as we have any, is ridiculously too small, or that Prussia operates more wisely than we are doing.

*Die Bronzen und Kupferlegirungen der Alten und ältesten Völker etc.* Von Dr. Ernst F. von Bibra. 1 vol. 8vo. Erlangen, 1869.

This is such a book as no one but a German could produce, no country but Germany could publish; we write it to the honour of both. The work is, perhaps, of greater interest to the archæologist than to the metallurgist or founder; but the latter will not hear without interest that we have here, collected with laborious care, all the authenticable facts as to the knowledge of the metals, and of the methods of combining them into alloys, of the most ancient nations of the old world, literally from China to the Pillars of Hercules, and from Africa to the frozen zones of Scandinavia. The work is full of most curious and interesting and suggestive matter, and collected from many sources. There are given in tables—locally and chronologically arranged—literally hundreds of analyses of the alloys of copper &c. employed by all the ancient nations of the world for divers purposes, privatc and public. Multitudes of these are by Von Bibra himself. The discussion of these would throw a good deal of fresh light on the mining of the ancients.

## CORRESPONDENCE.

☞ We do not hold ourselves responsible for the views or statements of Correspondents.

TO THE EDITOR OF THE PRACTICAL MECHANIC'S JOURNAL.

Sir,—In your issue of March last you published a paper which was read to the Royal Society of Edinburgh, on "Intensified Gravity in Centrifugal Governors," by Professor Smyth, who in his concluding remarks urged the necessity of the public taking active steps in preventing Ocean-going Screw-Steamers being sent to sea without an efficient governor, to prevent the screw revolving any quicker in air than in water, as the racing of the engine often leads to serious and sometimes fatal consequences.

As I have been a reader of the *Practical Mechanic's Journal* for a number of years, and have taken a deep interest in some of the subjects which have been discussed in its pages, I now submit to your consideration a plan for regulating marine engines, which will be more immediate in its action than any kind of centrifugal governor, as it will give and cut off steam the moment it is required, its action being independent of the revolutions of the engine.

My plan is to connect the throttle-valve of the engine in a suitable manner to a float for regulating the steam, by fixing a tube in the ship (as near the screw as possible), open at top and bottom, so that the swell of the wave will rise and fall in it the same as outside; and as the tube will not always be in a vertical position, on account of the pitching and rolling of the ship, the float can be mounted with wheels, and made to work in guides in a framework by itself, and placed in the tube so that it can be taken out and repaired at any time when necessary. As the receding wave will go down in the tube at the same speed and to the same level as outside at the screw, that whatever part of the screw be left bare, the float will cut off its corresponding quantity of steam. Suppose the diameter of the screw to be five feet, the float to rise and fall between two stops the same distance; when the screw is covered the float will be up at the top stop, giving full steam; when half covered the float half down, giving half steam; and when wholly bare, the float full down shutting the throttle-valve, leaving as much steam passing through as to keep the engine going at her regular speed.

Thus, you will observe that, whatever work the waves give the engine to do, they at the same moment give the exact quantity of steam to perform that work; and when the sea is calm and the screw continually covered, the float will be at rest, buoyed up against the top stop ready for action when another gale springs up.

As the bringing forward of more ideas often tends to a deeper investigation of the subject under discussion, and as you in your notice of the paper expressed a hope of making remarks on the subject in future, I now humbly submit the above to your careful consideration.

Yonrs most respectfully,

Prestonpans: GEORGE PRINGLE.
28th August 1869.

We willingly publish our correspondent's letter, but as it appears he has not seen Professor Smyth's "Intensified Gravity Governor" in action, he clearly is not in a position to assert on certain knowledge that his proposed method of acting upon the throttle-valve of marine engines will be "more immediate in its action than any kind of centrifugal governor." Whilst we ourselves have carefully examined, both in and out of action, the governor which regulates the driving clock of the equatorial at the Edinburgh Royal Observatory—both with and without the agency of "intensfied gravity"—we are in a position to say that we feel confident the float regulator proposed by our correspondent would not act so immediately as the governor does; there are, besides, several practical objections to employing such a regulator as that now proposed, not the least of which would be the certainty of the apparatus being either rendered inoperative or broken in any severe storm, unless made objectionably heavy, by the mere impulse of the water rising in the tube at a high velocity, as the vessel descends with such terrific blows into the wave-trough, and again at rising over the succeeding crest. Nor is this all; for, as our correspondent proposes to place his tube as near the screw as possible, he must have overlooked the fact of the hollow or depression produced in the water by the dispersing action of the screw, and the recession of the ship's stern from the water in the wake. Whilst there is certainly a mark of ingenuity in our correspondent's proposal, and which, no doubt, if practicable, would be very advantageous, yet it is quite clear that a float in an open tube would get shot about severely by the waves, and if to decrease their effect the entrance to the tube be made small, then there would be loss of time; moreover, the connection between a quickly moving engine *inside* the ship, and a regulator at some distance from it, does not look at all likely to fulfil the end sought. V. D.

# PROCEEDINGS OF SCIENTIFIC SOCIETIES.

## THE MEETING OF THE BRITISH ASSOCIATION AT EXETER.

This Association held its Thirty-ninth Annual Meeting at Exeter, on the 18th of August last, and notwithstanding the many highly successful meetings by which it had been preceded, it has on no occasion been surpassed, whether regard be had to the variety or importance of the subjects discussed, or the ability and completeness with which they were handled. We regret that the paucity of space at our command prevents us doing little more than noticing in the briefest possible manner either the addresses delivered or the papers read.

Proceedings commenced with a meeting of the general committee, held in the Albert Memorial Museum, at one o'clock on Wednesday. The president, Dr. Hooker, LL.D., F.R.S., &c., occupied the chair. There were about 150 noblemen and gentlemen present.

The general assistant secretary (Mr. Griffith) read the minutes of the general committee meetings at Norwich, which were adopted.

The general secretary (Professor Hirst) read the report of the council for the year 1868-69. The council reported that, in accordance with instructions from the general committee, they have prepared and caused to be presented to Parliament petitions praying the Houses to pass such measures as would remedy the existing defect in secondary education in schools. The council had prepared a petition which was presented to the House of Lords by Lord Lyttelton, and to the House of Commons by Sir W. Tite. The petition was given in full in this report; one of the principal points was that which pressed upon the attention of Parliament the advisability of introducing more generally the study of natural science into secondary schools. The council have also appointed a committee, consisting of Sir Henry James, Sir C. Wheatstone, Mr. Godwin-Austen, Professor Tyndall, Professor Ramsay, the president, general secretaries, and treasurer, to consider the question referred to them by the general committee, of urging upon Government, and through the British Government upon the Governments of foreign nations, the importance of fixing, by permanent bench marks, certain points of level, and also of position in reference to secular changes in the elevation of land as referred to the sea-level, and in relation to changes of coast-line and to the position of ice-masses, and also to consider to ask the support and co-operation in this of the council of the Royal Society. The Royal Society have agreed to co-operate with this council in the matter, and the committee has not yet finished its labours. It was reported that the following foreign men of science, who were present at the Norwich meeting, have been elected corresponding members:—Baron Von Mädler, Dorpat; Padre Secchi, director of the Observatory at Rome; Professor Aug. Morren, Doyen de la Faculté de Sciences, Marseilles; Professor Vogt, Geneva; Professor Broca, Paris; Professor L. Radlkofer, Munich; Professor Karl, Koch; M. D'Avesac, Mem. de l'Institut de France; Dr. H. A. Weddell, Poitiers; M. A. Heynsius, Leyden.

The report was adopted.

The general treasurer (Mr. Spottiswoode) read his financial account from August 20, 1868, to August 18, 1869, from which it appeared that the balance brought forward was £177 1*s.* 7*d.* Among the receipts were the following items:—Received for life compositions at Norwich meeting and since, £220; annual subscriptions, £624; associates' tickets, £720; ladies' tickets, £682. The expenses of the Norwich meeting, with the addition of sundry items for printing, binding, &c., amounted to £346 4*s.* 3*d.* The grants to science at the Norwich meeting amounted to £622. The balance now in hand was £177 1*s.*

The report was adopted.

Mr. J. P. Gassiot, F.R.S., F.C.S., &c., read the heads of the report of the Kew Committee for 1868-9.

The report was adopted.

The presidents, vice-presidents, and officers of sections were then appointed. The secretaries of sections were also appointed. The Committee of Recommendation was appointed as follows:—The president and vice-presidents of the meeting; the presidents of former years; the trustees; the general and assistant-general secretaries; the presidents of sections, and the following gentlemen:—C. Spence Bate, F.R.S., F.L.S.; J. P. Gassiot, F.R.S., F.C.S.; R. Godwin-Austen, B.A., F.R.S., &c.; Professor Huxley, F.R.S.; Sir John Lubbock, Bart., F.R.S., &c.; Professor W. Allen Miller, M.D., LL.D., &c.; Rev. B. Price, M.A., F.R.S., &c.; Professor Rankine, LL.D., &c.; Sir C. Wheatstone, D.C.L., F.R.S., &c.; Professor A. W. Williamson, F.R.S., &c.; Professor Perceval; E. Perceval Wright, M.D., F.L.S., &c.

The lists were agreed to.

In the evening the president, Mr. George Stokes, M.A., Sec. R.S., D.C.L. Oxon, LL.D., Dublin, Fellow of Pembroke College, and Lucasian Professor of Mathematics in the University of Cambridge, delivered the inaugural address.

He commenced by giving an account of the origin and purpose of the Association, viz. the giving of a more systematic direction to scientific inquiry, and the organising of means for the prosecution of researches which require co-operation, apart from the vast amount of time and thought expended on researches through the medium of the society. Something may be conceived as to what has been done by means of the pecuniary outlay caused by grants for defraying the expenses of such researches, and which up to the year 1867 amounted to £29,288 8*s.* 1*d.*

Passing to a historical sketch of the most recent progress of science, the President took up the subject of astronomy; and having traced its progress through Newton, Adams, and Le Verrier, he argued that it might have been supposed, after the brilliant achievements of these discoverers, that the field of astronomical research must have been well nigh exhausted. But researches which had been carried on within the last few years, even within the last twelve months, showed how shortsighted such an anticipation would have been, and proof had been given of the value of the union of one science with another. In an elaborate but untechnical disquisition, Dr. Stokes explained how the sciences of astronomy and optics had acted upon and assisted each other, astronomy being indebted to optics for instruments essential to its development, while astronomy had repaid its debt to optics by an important result, namely, the first proof of the finite velocity of light, and the first numerical determination of that enormous velocity. By means of optics, and especially by means of the spectroscope, the motion and the masses of the heavenly bodies had been more fully revealed to astronomical observation. The theory of 'fixed stars' was next dwelt on, the result being laid down that the term was not wholly exact, inasmuch as it was proved that the stars, including the first and greatest of stars—the sun—or some of them at least, are moving in various directions in space, and that it is merely the transversal component of the whole motion, or rather of the motion relating to our sun, that is revealed to us by a change in a star's apparent place. In regard to determining whether any particular star is approaching or receding from the sun, astronomy alone was powerless to help researches; and here the science of optics came in in a remarkable manner. By an analogy, between the sound of a bell and the vibratory movement of light, it was shown that, by means of optical science, evidence had been obtained that light consists of a tremor or vibratory movement, propagated in an elastic medium, filling the planetary and stellar spaces—a medium which thus fulfils for light an office similar to that of air for sound. Here opportunity was taken to illustrate the theory propounded by references to the researches in regard to the solar spectrum of Professor Kirchhoff, and the result of observations obtained by the use of a telescope furnished with a spectroscope of high dispersive power by Mr. Huggins, in the solar system, and which presented a grand conception of the unity of plan pervading the universe.

The President then turned to a recent application of spectral analysis, in the observation of the total eclipse of the sun, August 17, 1868; the use of which was carried out on that occasion by two expeditions from England, to the countries crossed by the line of central shadow, under the auspices of Captain Herschel and Major Tennent. The information received had proved to be most valuable, and was a special illustration of the reacting on each other of astronomy and optics. He congratulated the Association on having attained an object for which it has been labouring ever since 1849, namely, the establishment of adequate instruments for astronomical observations in the southern heavens, which had at last been achieved by the erection of a telescope at Melbourne, Australia, for which a grant of £5,000 had been made by the Colonial Legislature, and which is now under the superintendence of Mr. Le Sueur. An account was next given of the issue of an inquiry by a Royal Commission, appointed at the instance and by the pressure of the Association, into the application of gun-cotton to warlike purposes. Next it was stated that, owing to the exertions of the Royal Society, soundings in great ocean depths had been undertaken by the Admiralty, and dredging had been carried down to more than 2,400 fathoms, and animal life had been found in that depth in considerable variety; while, in a depth of 650 fathoms, the existence was established of a varied and abundant fauna, at depths which had been supposed to be either azoic or occupied by animals of a very low type; besides which the character of the fauna and the mud brought up was such as to point to a chalk formation actually going on.

In regard to chemistry, it was stated that no great step had been made; but an account was given of the discovery of the existence of a red colouring matter obtainable from the wings of the turaco, or plantain-eater, of the Cape of Good Hope, a bird celebrated for its beautiful plumage; and another of the improvement of alizarine, one of the components of madder, which occupies so important a position amongst dye-stuffs of calicoes. Again, it was stated that by the action of hydrochloric acid on morphia a new base was produced, whereby the narcotic properties of morphia were changed, so that it became a powerful emetic, unattended by injurious after-effects. In relation to mechanism, allusion was made to this being the centenary of the great invention, the steam-engine.

The last subject comprised in the address was the branches of science more or less concerned with the phenomena of life, in which the bearing of physical on biological science was dwelt upon. This was argued out with great minuteness and ingenuity.

## SECTION A.—MATHEMATICAL AND PHYSICAL SCIENCE.

August 19.—The President (Prof. J. J. Sylvester) opened this section with an address which was mainly intended to prove the paramount importance of the faculty of observation to the process of mathematical discovery, and in opposing an assertion of Prof. Huxley, "who in this instance is speaking of the sciences as they are in themselves, and without any reference to scholastic discipline," that Mathematics "is that study which knows nothing of observation, nothing of induction, nothing of experiment, nothing of causation."

Report of the Lunar Committee.—In introducing this Report the Secretary, Mr. W. R. Birt, referred to the progress of selenographical research since the Committee was appointed at Bath, in the year 1864. A surface of 100 square degrees, i.e. 10° of S. latitude, and 10° of W. longitude, has been surveyed during the period; the outlines of 433 objects, laid down on a scale of 200 inches to the moon's diameter; and a catalogue prepared, which contains notices of phenomena bearing on questions which have been mooted relative to the physical aspect of the moon's surface.

"Provisional Report on the Repetition and Extension of Prof. Forbes's Experiments on Thermal Conductivity," by Prof. P. S. Tait.

"Report on the best means of Determining the Real Amount of Evaporation from the Surface of Water," by Messrs G. J. Symms and R. Field.—After a few words on what the authors believe to be the great source of error in all existing forms of evaporator, namely, undue heating of the water experimented upon, they proceeded to describe a series of experiments at Dijon and other places on the Burgundy Canal. The authors epitomised the results, showing what very erroneous measurements were yielded by even the best of ordinary evaporators, and concluded with a strong plea for further investigation by quoting the words of M. Vallès:—"We do not understand how in a country like ours, and with reference to one of the most important of hydraulic data, we can rest content with only knowing that

the numerical value of this datum lies between two limits, one of which is double the other."

"On Secular Variations of Lunar Tints," by Mr. W. R. Birt.

"On Spots and Shadows in the Lunar Crater Plato," by Mr. W. R. Birt.

"On the Relation between the Specific Refractive Energies and the Combining Proportions of Metals," by Dr. J. H. Gladstone.—In a diagram were exhibited the names of the metallic elements arranged in the order of their specific refractive energies, that is, their index of refraction minus unity divided by density, and which had been determined mainly from solutions of their salts. Another column exhibited the combining proportions of the same metals, that is, the actual amount which will combine with an equivalent of some other element, say 35·5 of chlorine. The numbers in this column were, with one or two clear exceptions, in the reverse order of the preceding. The relations between the figures have not the exactness of a physical law, but they show a connexion between the power of a metallic element to retard the rays of light and its power to saturate the affinities of other bodies. The same relation does not hold good with regard to non-metallic elements.

"Report of the Underground Temperature Committee," by Prof. Everett.—The report commenced by describing a strong but very sensitive form of thermometer which had been designed for the purposes of underground observation by Sir W. Thomson, and stated that instruments of this class will be sent to persons undertaking to make observations in artesian or other borings. Details were then given of the principal observations made during the past year.

"Summary of the Thermodynamic Theory of Waves of Finite Longitudinal Disturbance," by Prof. W. J. Macquorn-Rankine.—This paper contained a summary account of the results of a mathematical investigation, the details of which have been communicated to the Royal Society. It relates to the laws of the propagation of finite longitudinal disturbance along a cylindrical or prismatic mass of an elastic substance of any kind, solid, liquid, or gaseous.

"Description of a new Self-Recording Aneroid Barometer," by Mr. Martin.—The purpose of the instrument is the production of a permanent record of those important fluctuations of atmospheric pressure which, occurring between the stated hours of observation, either pass entirely unnoticed or remain unregistered.

"On a Self-Setting Type-Machine for recording the Hourly Horizontal Motion of the Air," by Mr. C. J. Woodward.

August 20.—Report of Committee appointed at Norwich (Lieut.-Col. Strange, chairman) for the purpose of reporting the opinion at which they may arrive concerning the questions—1. Does there exist in the United Kingdom sufficient provision for the vigorous prosecution of physical research? 2. If not, what further provision is needed? and what measures should be taken to secure it? The Committee reported that the provision now existing is far from sufficient for the vigorous prosecution of physical research. They recommended that the influence of the Association should be exerted to obtain the appointment of a Royal Commission, to consider—1. The character and value of existing institutions and facilities for scientific investigation, and the amount of time and money devoted to such purposes. 2. What modifications or augmentations of the means and facilities that are at present available for the maintenance and extension of science are requisite; and 3, In what manner these can be best supplied.

"On the Best Forms of Numerical Figures for Scientific Instruments, and on a proposed mode of engraving them," by Lieut.-Col. Strange.

"On the Absorption, Emission, and Reflection of Heat," by Prof. G. Magnus.

"On the Appearance of the Nebula in Argo, as seen in the great Melbourne Telescope," by the Rev. Dr. Robinson.

"Remarks on the British Association Catalogue of Stars," by the Rev. R. Main.

"On the Longitude of the Radcliffe Observatory, Oxford, as determined by Meridional Transits of the Moon, made at Greenwich and Oxford in the years 1864-8," by the Rev. R. Main.

"Shooting-Stars observed by Mr. J. Lucas on the nights of the 9th, 11th, 12th, and 13th of August 1869," communicated by the Rev. R. Main.

"On the Discordance usually observed between the Results of Direct and Reflexion Observations of North Polar Distance," by the Rev. R. Main.

"On Comets," by Prof. P. G. Tait.

"On Metallic Deposits in Vacuum Tubes," by Mr. J. P. Gassiot.

"On a Method by which the Formation of certain Chemical Compounds may be optically established," by the Rev. Prof. Jellett.

August 20.—"Report on the recent Progress in the Theory of Elliptic and Hyper-elliptic Functions," by Mr. W. H. L. Russell.—In this report elliptic functions are divided into four sections, of which the first two make up the subject of the present communication; the functions known as "$\theta$ functions" occupying the principal part of it, and the author has endeavoured to give an accurate account of what is known respecting them.

"On a New Self-registering Hygrometer," by Mr. E. Vivian.—The principle upon which Mr. Vivian's instrument is constructed is the condensation of the vapour of alcohol, from a reservoir representing the dry bulb, which passes *in vacuo* into a wet bulb. The action is cumulative for any period. The same principle is applied by a modification of the same instrument,—1. To the registration of the mean difference between sunshine and shade; both bulbs being dry and one shaded. 2. To nocturnal radiation; one bulb being exposed, the other protected from the direct influence of the sky. 3. The approximate record of mean temperature, 50° being taken as the *datum* in constructing the hygrometrical scale, and the *plus* or *minus* representing temperature. 4. As a pluviometer, showing the duration of rain during any period; one of a pair of instruments having its bulb wetted by rain through a flannel, the other kept constantly wet by a cistern.

"On Professor Christian Wiener's Stereoscopic Representation of the Cubic Eikosi-Heptagram," by Professor Sylvester.

"On the Umbilici of Anallagmatic Surfaces," by Mr. W. K. Clifford.

"On the Theory of Distance," by Mr. W. K. Clifford.

"Sketch of a Proof of Lagrange's Equations of Motion referred to Generalised Co-ordinates," by Mr. R. B. Hayward.

"On Conic Osculation," by Mr. F. W. Newman.

"On Surfaces of the Second Degree," by Mr. F. W. Newman.

"On Curves of the Third Degree," by Mr. F. W. Newman.

"On the Common Tangents of Circles," by Mr. M. Collins.

August 22.—"Report of the Committee appointed to apply to the Admiralty for Aid in observing certain Sea Temperatures," by Sir E. Belcher.

"Report of the Tidal Committee," by Professor Rankine.

"Report of the Rainfall Committee," by Mr. G. J. Symons.

"Recent Fall of an Aërolite at Krähenburg," by Dr. Neumayer.

"Results of Experiments with a Captive Balloon," by Mr. J. Glaisher.

"On the Rainfall in Natal, South Africa," by Dr. R. J. Mann.

"On the Formation of Dew," by Dr. Hudson.

"On Chambered Spirit-Levels," by Mr. Warner.

"On the Speed of Air in Flues," by Mr. A. E. Fletcher.—This paper described the author's new anemometer, whereby he is able to measure the speed of air moving in red-hot flues or air-passages, and in cases where it may be mixed with corrosive vapours which would prevent the use of the older mechanical anemometers.

"On the Manry Barometer," by Mr. F. T. Mott.

August 23.—"On the Penetration of Armour-Plates by Shells with Heavy Bursting-Charges fired obliquely," by Mr. J. Whitworth.

"Sur une Méthode pour obtenir les Images Monochromatiques des Corps Luminenx," by M. Jannsen.

"Faits divers de Physique Terrestre," by M. Jannsen.

"On the Chemical Re-action of Light discovered by Professor Tyndall," by Professor A. Morren.

"On the Formation of Dew," by Mr. H. Hudson.

"On the Numerical Relations between the Wave-lengths of the Hydrogen Rays," by Mr. G. J. Stoney.

"On a Convenient and Cheap Heliostat," by Mr. G. J. Stoney.

"On the Influence of Annealing on Crystalline Structure," by Mr. C. Brooke.

"On the Mechanical Tracing of Curves," by Mr. W. H. L. Russell.

"On the Successive Involutes to a Circle," by Professor Sylvester.

"On an Electro-Magnetic Experiment," by the Hon. J. W. Strutt.

August 24.—"Report of the Committee on Luminous Meteors," by Mr. J. Glaisher.—The report contains the results of assiduous observation of shooting stars, directed principally to the periodical dates when shower-meteors are usually expected to recur, besides the recorded description of many large meteors, which have appeared with more than ordinary frequency since the last report, and the fall of aërolites.

"On Electrification," by Mr. T. Bruce Warren.

"On the Electrical Balance," by Mr. F. H. Varley.

"On Collimators for adjusting Newtonian Telescopes," by Mr. G. J. Stoney.

"On Meteorological Reductions, with especial Reference to the Elements of Vapour," by Mr. B. Stewart.

"On a Self-recording Rain Gauge," by Mr. B. Stewart.

"On the Heat of the Stars," by Mr. W. Huggins.

## MONTHLY NOTES.

INDIAN RAILWAYS.—Of the existing 4,096 miles of railway, 174 were opened during the past year. No very important addition is likely to be made to the extent of open railway during the ensuing year. A further section of the Delhi line will probably be finished, as well as another portion of the north-west branch of the Madras Railway. But the completion of the chord line of the East Indian Railway and the last section of the Delhi line, which will have the effect of bringing Calcutta into direct and uninterrupted communication with Lahore, by a railway 1,500 miles in length, must not be expected until the autumn of 1870. About the same time the railway between Bombay and Calcutta will probably be completed. With regard to schemes for future railway extension, the line joining Lahore with the north-west extremity of the empire at Peshawur, which had already been determined on, is now being staked out. As respects other undertakings, the Government of India having been invited to report the lines which are most called for, and the order in which they should be constructed, submitted a comprehensive scheme for the extension of railway communication throughout India, as well as an exposition of their views upon the agency by which it should be carried out. With regard to the latter question, it is thought that the future lines should, so far as is consistent with actual and implied engagement with existing companies, be carried out by the Government itself. This recommendation is based upon the belief that expenditure will be kept more under control than when incurred through the agency of companies; that the cost of future lines will, in consequence, be much diminished; and that if at one time India was wanting in experience, she now possesses all the knowledge requisite in dealing with the administration and construction of railways. With regard to the lines which are to be undertaken, the proposal is that the construction of such a system of railways should be commenced as appears likely to give a tolerably complete network of main lines, traversing all parts of India, in which considerations of policy, or the probable requirements of the trade and internal convenience of the country, indicated the utility of opening such lines, and give sufficient grounds to anticipate the eventual growth of a traffic which would pay the interest on the cost of construction. The rate of progress will depend upon the amount of capital upon which the Government can afford to pay interest out of the revennes. It is computed that 10,000 miles, in addition to the 5,000 which are either open or in course of construction, would provide necessary communication through all the chief provinces; that by an annual expenditure of

£3,750,000, 300 miles could be opened every year, supposing the cost to be £12,000 per mile; and that thns in abont thirty years all the requirements of India would be met, without either extraordinary taxation, inconvenient pressure on the public revennes, or objectionable increase of the liabilities of the State. The immediate commencement of operations on the Indns Valley line, on the Rajpootana line, on the line from Kulburga to Hyderabad, and on that from Carwar, a port sonth of Bombay, to Hooblee, have been authorised, and negotiations have been entered into with the Bombay and Baroda Railway Company for the construction of a branch from their line at Ahmedabad to Veerungaum and Wudwan, with the Great Sonthern for the continnation of their railway to the port of Tuticorin, and with the Indian Tramway Company for the extension of their line to Cuddalore. The estimated cost of the lines, as at present sanctioned, is £97,200,000. Of this £14,000,000 remains to be raised, but the expenditure will be spread over five or six years. Of the £82,376,620 which has been raised, only £800,781, or less than 1 per cent., was subscribed in India! The capital which has been expended, exclnsive of the cost of land, amounted on the 31st March last to £78,986,655, of which £4,548,638 was expended dnring the past year. The expenditure in this country last year was £1,935,012, in India £2,613,626. The average proportion per cent. of the expenditure in England and India is 66 in the former and 34 in the latter. The nnmber of persons who as proprietors of Indian Railway stock are directly interested in the success of these nndertakings has now risen to 45,055, an addition of 4,015 having been made dnring the year. There are debenture holders also to the nnmber of 8,444. Stores and materials to the amount of 188,858 tons and of the valne of £1,849,554 have been sent out during the year, making a total of 3,718,049 tons, which, at a cost of £25,052,135, have been shipped from this conntry to India since the commencement of railway operations there. The net revenue for the year ending the 30th of June 1868 was £2,100,122, being £237,178 less than that of the previous year. The gross receipts were £4,831,395, and the working expenses were £2,731,273, as compared with £4,875,112 and £2,537,812 of last year. The falling off is confined to goods traffic. The passenger traffic shows an increase both in nnmbers and receipts. Comparing the two last years, the amonnts realised from passengers were £1,591,475 and £1,376,812 respectively. That from goods in 1867-68 was £3,135,481; in 1866-67, £3,326,607. The nnmber of passengers conveyed was 15,066,530 as compared with 13,746,354 of the previous year, and 12,867,000 of the year before that. Of the 15,000,000 conveyed last year only 130,000, or less than 1 per cent., were first class, and 535,000, or abont 3½ per cent., were second class. The whole amount that has been advanced by Government for gnaranteed interest from the beginning in 1849, including £3,700,000 last year, now exceeds £25,700,000. Of this abont £13,650,000 has been paid back by the companies out of the railway earnings.

Drawing Schools in Wurtemberg.—Classes for industrial drawing were added to all the primary schools of Wurtemberg after the Universal Exhibition of 1851, to enable the mannfactnrers of the conntry to compete with France in the industrial arts. These schools were at first gratuitous, but experience proved that attendance was better secured by reqniring a small payment, varying according to the means of parents, from tenpence to twenty sbillings a year. The teachers are, as far as possible, chosen from among the workmen or masters of the chief industries of the place, who, having been tanght in the same schools, have there acquired the requisite knowledge. But these workmen thus made teachers do not abandon their trades, and receive only a remnneration of abont three shillings and fonrpence per hour's lesson. They generally give three a week of two hours each, from seven to nine o'clock in the evening. At Geisslingen, for instance, there is a school where 180 scholars are taught by a master mason. In more than one parish the heads of establishments so much valne the importance of this instrnction that they themselves send their yonng workmen and apprentices to the schools. It has been remarked that artists of considerable talent have not succeeded so well as masters as mere artisans; which proves that there would not be so mueh difficulty as is snpposed in expeditiously training teachers for this kind of school. The Department of Trade has adopted examples to be used in all these schools, of which the first series intended for beginners consists of lithographs, easy and few in number, merely for practice to give freedom to the hand, while accustoming the pupil to guide it hy the eye. The next step for the pnpils is to draw from plaster models, graduated from the most simple figures to the finest casts from the antique, which are reserved for the principal schools. Besides these models in relief, the Department of Trade has formed a collection of the best pnblications on indnstrial art, from the most costly to the hnmblest albnms of furnitnre, cabinet work, bronzes &c. It distributes these works throughout the conntry, lending them to the masters of the schools for a certain period, usually one month. Every other year the schools send to Stuttgart a collection of their drawings of all kinds for exhibition, after which prizes are given to those which sent the finest prodnctions. The masters themselves are invited to attend this exhibition, and to control the awards made. From among the most skilful masters a certain number are chosen, who go ronnd to the schools as inspectors.

Whitworth Scholarships.—The following is a list of the successful candidates, with their ages, occnpations, and the nnmber of marks they obtained, who have been reported to the Science and Art Department as entitled to the 10 Whitworth Scholarships of £100 a year each:—William H. Greenwood, aged 23, engineer-stndent at the Mechanics' Institntion, Manchester, 143 marks; Thomas A.Hearson, aged 23, engineer-student, Royal School of Naval Architecture, 137 marks; John Hopkinson, B.Sc., aged 19, stndent at Cambridge University, 134 marks; Thomas S. Elgood, aged 24, mechanical engineer, Leicester, and Owens College, Manchester, 127 marks; George A. Greenhill, aged 21, student at Christ's Hospital School and Cambridge University, 116 marks; John R. Brittle, aged 23, engineer-student at Sir Walter St. John's School, Battersea, 113 marks; Thomas W. Philip's, aged 23, stndent at British School, Millwall, and Royal College of Science, Dublin, 100 marks; Richard Sennett, aged 21, engineer student at the Royal School of Naval Architectnre, 98 marks; Robert B. Buckley, aged 21, engineer-stndent at Merchant Taylors' School, 97 marks; Charles E. Leeds, B.A. (Oxon), aged 23, student at Oxford University, 96 marks.

## APPLICATIONS FOR
# PROVISIONAL PROTECTION FOR INVENTIONS
## UNDER THE PATENT LAW AMENDMENT ACT.

☞ When the city or town is not mentioned, London is to be understood.

*3rd August* 1869.

2319 J. Pinchbeck, Whiskin Street, Clerkenwell—Gas meters
2320 H. Turner, Plaistow—High and low pressure expansive condensing steam engines
2321 C. D. Abel, Southampton Buildings—Mechanism for converting reciprocating rectilinear motion into rotary motion, and for converting rotary motion into reciprocating rectilinear motion.—A com.
2322 E. Beanes, Cordwalles, near Maidenhead—Re-working wrought-iron
2323 A. Louden, Ceres, Fife—Taps or cocks
2324 T. Grace, Bristol—Apparatus for stoppering bottles
2325 W. E. Gedge, Wellington Street, Strand—Curry comb—A com.
2326 C. Tner, R. Howarth, and J. Pimbley, Farnworth—Machines for polishing threads
2327 J. T. Way, Russell Road, Kensington—Improvemcuts in the manufacture of manures and in the purification of gas
2328 J. T. Way, Russell Road, Kensingtou—Improvements in the manufacture of soap and in cleansiug wool and woollen goods
2329 J. Bapty and A. Hall, Massachusetts, U.S.—Mechanism for spinning wool or other fibrous matters—A com.
2330 I. Davies, Harhorne, Stafford—Rotary gas exhausters

*4th August* 1869.

2331 T. Livesey and T. Abbott, Blackburn—Boiling size
2332 E. Hafner de Bodmer, Paris—A new kind of carriage wheels with springy spokes and eccentric nave
2333 F. C. Colney, Paris—Mechauism for the propulsion of vehicles
2334 G. Broadhurst, Manchester—Waterproof coats, capes, cloaks, and leggings
2335 G. S. Hazlehurst, Runcorn—Apparatus to be employed as a medium of communication between passengers, guard, and engine driver on railway trains
2336 J. Booth, Shipley, and R. W. Morrell, Bradford—Improved textile fabric
2337 W. T. Ramshill, Deptford—Heels for boots and shoes
2338 G. C. Ramsey, Aldermanbury—Circular boxes
2339 J. Taylor, Herne Bay—Attachment or device for balancing toilet and other looking-glasses

*5th August* 1869.

2340 A. Tylor, Newgate Street—Apparatus for regulating, adjusting, and comparing the standards of measures
2341 J. Elce, and R. Bond, Manchester—Self-acting temples for looms
2342 W. Brown, Smethwick—Machinery for rolling rails and girdere
2343 G. W. Murray, and G. M. Garrard, Banff, N.B.—Apparatus employed in plonghing and tilling land
2344 J. U. Fairbairn, Southampton—Velocipedes
2345 E. Beanes, Cordwalles, near Maidenhead—Preserving articles of food
2346 B. J. B. Mills, Southampton Buildings—Meters for measuring liquids and gases.—A com.

*6th August* 1869.

2347 E. Cocking, Bradford—Construction of easy chairs
2348 E. Rihoux, Paliseul, Luxembourg—A life-preserving dress
2349 J. and A. Garde, Bordeaux—Ventilating hat
2350 B. Hunt, Serle Street, Lincoln's Inn—Numbering register or apparatns.—A com.
2351 W. B. Rust, Sheffield—Portfolio or case for the preservation of lettere aud docnments in an alphabetical or other orderly manner
2352 C. J. Chubb, Endsleigh Street, Tavistock Sqnare—Drills and apparatus for boring holes in coal, hard ground, slate, and minerals
2353 T. Leach, Tramere, Chester—Composition for coating the bottoms of iron ships and other navigable vessels, &c.
2354 W. R. Lake, Southampton Buildings—Devices for holding the chimneys of gas-burners and other lighting apparatus.—A com.
2355 W. R. Lake, Southampton Buildings—Expanding drills for boring rocks.—A com.

*7th August* 1869.

2356 W. Tongue, Brixton—Machinery for generating elastic vapours and applying snch vapours for producing motive-power
2357 E. W. Hawes, Clontarf, Dublin—Construction of buoys
2358 W. Manwaring, Banbury—Harvesting machines
2359 D. Ridge, Smethwick, Stafford—An eccentric lever polygonal boring brace, to be used in place or in lieu of the ordinary ratchet brace
2360 G. Nickerson, Barningham, Suffolk—Apparatus for raising and stacking straw &c.
2361 W. Guest, Ardwick, Manchester—Cleaners used in machinery for preparing and epinning cotton, &c.
2362 H. Brandreth, Manchester—Cutter to be employed in the manufacture of saw handles
2363 I. Brown, Edinburgh—Irrigating and manuring land
2364 W. E. Newton, Chancery Lane—Purifying or disinfecting alcohol and alcoholic liquors.—A com.
2365 J. Mitchell, and T. Settle, Bolton—Manufacture of "Marseilles quilts"
2366 A. B. Ibbotson, Sheffield—Joints for uniting and securing the ends of railway rails
2367 W. R. Lake, Southampton Buildings—Machine for sowing aud covering seed and for cultivating land.—A com.
2368 W. R. Lake, Southampton Buildings—Machinery for combing fibrous materials.—A com.
2369 J. T. Greenfield, Dover—Life buoys
2370 G. Ritchie, Tyrwhitt Road, Lewisham Road—Construction of tents and sunshades or weather protectors suitable for carriages and other vehicles
2371 A. C. F. Franklin, Abingdon Street—Bearings and lubricating apparatus for screw propeller and other revolving shafts

*9th August* 1869.

2372 G. Rastall, Manchester—Velocipedes
2373 J. Quinton, Moorgate Street—Tobacco pouch
2374 S. Osborn, Sheffield—Knives and knife bars for reaping and mowing machines
2375 J. Staniar, and S. Dawson, Manchester, and E. Davies, Birmingham—Apparatus to be employed for the purpose of "dressing" or distributing the different qnalities of ground or pulverized grain into compartments or chambere
2376 J. Froggatt, Lenton, Nottingham—Pickers employed in the process of weaving
2377 J. H. Johnson, Lincoln's Inn Fields—Improvements in the manufacture of felted fabrics, and in the application of such fabrics to the manufacture of hats &c.—A com.
2378 C. E. Brooman, Fleet Street—Apparatus for carrying or storing eggs.—A com.
2379 A. Turner, Leicester—Utilizing waste strips of india-rubber &c.
2380 H. Wimshurst, Wandsworth Road—Improvements in marine propellers, and in vessels to receive the same
2381 G. F. Ansell, Bernard Street, Russell Square—Manufacture of iron and steel
2382 W. R. Lake, Southampton Buildings—Apparatus for adding numbers.—A com.

*10th August* 1869.

2383 E. A. Curley, Bartholomew Close—Application of reciprocating or intermittent motive-power
2384 R. Longdon, Manchester—Safes and refrigerators
2385 T. Hancox, Sheffield—Apparatns for rolling metallic axles for wheels
2386 C. Lockman, Hamilton, Ontario, Canada—Automatic thread regulator for sewing machines
2387 E. T. Hughes, Chancery Lane—Rock-boring machinery.—A com.
2388 C. W. Zenger, C. L. Strube, and L. Merlett, Buckau, Prussia—A globular-cylinder manometer with double capillary lock
2389 S. Hutchinson, Leeds—Apparatus for "striking-out" leather
2390 J. E. Holmes, Buckingham Street, Strand—Cutting and dressing stone
2391 T. S. Blair, Pittsburg, Pennsylvania, U.S.—Manufacture of iron and steel
2392 T. S. Blair, Pittsburg, Pennsylvania, U.S.—Treatment of conglomerates of cast-iron and other substances
2393 J. Caddick, Birmingham—Candlesticks
2394 F. Mazet, Marseilles—Improved match-box candlestick.—A com.
2395 S. J. Woodhouse, Leeds—Apparatus for purifying and regulating the supply of gas to burners
2396 W. Wright, Birmingham—Knobs and spindles
2397 H. Bessemer, Queen Street Place, Cannon Street—Fusion of metals &c.
2398 C. D. Watson, Liverpool—Waterproofing fabrics.—A com.
2399 A. H. Brandon, Paris—Metallic cartridges.—A com.

*11th August* 1869.

2400 J. Tenwick, Grantham—Lubricators
2401 A. B. Brown, Birkenhead—Hydraulic printing or copying presses
2402 J. B. Austin, Earl Street, Blackfriars—Producing and applying black, white, or coloured and shaded patterns of needlework on vellum, cloth, paper &c.
2403 C. Crossley and R. Whipp, Manchester, T. Crossley, Rochdale—Manufacture of size
2404 J. Cross and J. McCann, Farnworth, near Manchester—Manufacture of dry soap
2405 G. White, Queen Street, Cheapside—Pipes for smoking tobacco.—A com.
2406 F. H. Needham, Mortlake—Apparatus to be applied to casks or other vessels containing liquid, to preserve the liquid while on draught
2407 J. Mayer, Brooklyn, New York, U.S.—Hoop skirts
2408 A. M. Clark, Chancery Lane—Manufacture of phosphate of ammonia.—A com.
2409 J. H. Johnson, Lincoln's Inn Fields—Manufacture of iron and steel.—A com.

*12th August* 1869.

2410 J. F. E. Martin and L. G. la Quay, Randan, France—Submarine and other tunnels
2411 W. Davis, Great Yarmouth—Apparatus for stamping, crushing, and grinding ores
2412 J. Parrish, Bolton—Skips, hampers, and other baskets
2413 D. Barker, Northfleet—Manufacture of artificial fuel
2414 W. E. Newton, Chancery Lane—Centrifugal pumps.—A com.
2415 J. Deas, Glasgow and R. C. Rapier, Westminster Chambers—Lifting jacks for lifting railway rails
2416 W. R. Lake, Southampton Buildings—Machinery for charging gas retorts.—A com.

*13th August* 1869.

2417 H. Hudson, Wolverhampton—Apparatus for effecting communication between railway passengers, guards, and engine-drivers
2418 D. A. Gibbs, Milton Street—Compositions for coating or covering the sides and bottoms of ships and vessels
2419 E. J. Grabham, Shepherdess Walk—Apparatus for plaiting or folding textile fabrics, paper &c.
2420 C. E. Brooman, Fleet Street—Treating the waste of wool, silk, horn, and other nitrogenized animal matters to be used as manure.—A com.
2421 E. J. Hill, Victoria Station, Pimlico, and R. Davis, Craven Street, Strand—Signalling apparatus used in hand signal lamps
2422 T. Beckwith, Stockton-on-Tees—Reaping and mowing machines
2423 I. E. Woolf, New Bond Street—Casters.—A com.
2424 J. Cowan, Barnes, Surrey—Manufacture of soap
2425 J. Lewis, Liverpool—Extracting copper from its ores.—A com.
2426 J. Hampton, Wednesbury, and S. Partridge, Darlaston—Velocipedes
2427 W. Richards, Birmingham—Improvements in breech-loading firearms and in cartridges to be used therewith

*14th August* 1869.

2428 T. Sagar and T. Richmond, Burnley—Looms
2429 J. Kenyon, Blackburn—Apparatus for consuming smoke and saving fuel
2430 L. D. Newell, New York, U.S.—Apparatus for diminishing the effects of the oscillation of vessels and for preventing sea sickness
2431 W. Matt, Homerton—Compound or composition in imitation of marble, veneer &c.
2432 H. T. Yates, Nottingham—Production of cops and spoles
2433 T. Coad, Truro—Sewing machines
2434 S. Smith, Halesworth, Suffolk—Common road carriages
2435 E. H. C. Monckton, Threadneedle Street—Agricultural machinery
2436 J. B. Rushbrook, Bury St. Edmunds—Hurdle for folds for lambs and sheep
2437 G. Ash, Great Marlborough Street—Denture or appliance for carrying and supporting artificial teeth in the mouth by suction

*16th August* 1869.

2438 T. Ward and W. S. Black, King's Lynn—Machinery for twisting tobacco
2439 J. Mitchell, Bradford—Kilns for burning bricks, lime &c.
2440 H. Pinkus, Camden Road—Furnaces
2441 J. Blyde, Sheffield—Scissors or apparatus, especially suitable for gathering flowers and fruit
2442 H. Dupland, Paris—Coatings against dampness and saltpetre
2443 J. G. Dale and E. Milner, Warrington—Producing white pigments from lead
2444 G. Sunderland and R. J. Midgley, Salterlee Mills, near Halifax—Apparatus for spinning and doubling or twisting worsted, silk &c.
2445 H. A. Bonneville, Sackville Street—Charging and discharging fuel in gas retorts or other gas distilling apparatus.—A com.
2446 H. H. Trenor, New York, U.S.—Automatic passenger register
2447 S. Harvey, Haverstock Hill—Apparatus for indicating signals between passengers and guards in railway trains
2448 F. Ransome, Queen Street Place—Manufacture of artificial stone
2449 J. Lawson, Leeds, and E. G. Fitton, Leeds aforesaid—Spinning flax, hemp, jute, and tow

*17th August* 1869.

2450 T. J. Leigh, Brixton—Furnaces
2451 R. H. Charsley, Beaconsfield—Carriage for locomotion by manual labour
2452 H. B. Barlow, Manchester—Apparatus for dressing or preparing hides, &c.—A com.
2453 J. Eastwood, Blackburn—Apparatus for churning milk and mixing liquid compounds
2454 B. Hunt, Serle Street—For spinning yarns of flax, hemp, tow &c.—A com.
2455 J. Williams, Wigginton Rectory, Oxon—Improvements in maps and in scientific and educational diagrams to facilitate references and ascertain distances
2456 M. H. Jacobi, St. Petersburg—Galvanoplastic process for depositing iron.—Partly a com.
2457 R. F. Fairlie, Victoria Chambers, Westminster—Locomotive engines and carriages
2458 J. H. Johnson, Lincoln's Inn Fields—Manufacture of iron.—A com.
2459 W. R. Lake, Southampton Buildings—Pen-holders.—A com.
2460 W. R. Lake, Southampton Buildings—Machine for making sewing needles.—A com.

*18th August* 1869.

2461 J. Checketts, Wolverhampton—Window blind
2462 J. Jenkins, Camberwell—Treating and lining the interior of casks
2463 J. Prato and F. Polacco, Great Winchester Street—Charcoal filters for purifying water or other liquids
2464 J. Mackenzie, Cork—Machinery for sowing seeds and for distributing artificial manure
2465 E. T. Hughes, Chancery Lane—Manufacture of boots and shoes.—A com.
2466 A. Brown, Isle of Wight—Ground or earth screws
2467 T. Parkinson, Liverpool—Doors for regulating the admission of air to furnaces
2468 E. T. Hughes, Chancery Lane—Looms for weaving.—A com.
2469 R. F. Fairlie, Victoria Chambers, Westminster—Injectors for feeding steam boilers with water
2470 J. Lewis, Birmingham—Spring sackings for bedsteads
2471 G. Metcalf, Pertusola Foundry, near Spezia, Italy—Furnaces for obtaining lead from its ores
2472 J. Watson, Calcutta—Presses for compressing cotton &c.
2473 J. Mitchell, Sheffield—Machinery for forging, stamping, tilting, swaging, hammering or planishing metals
2474 H. W. Cook, Ovington Square—Turret and other large clocks

*19th August* 1869.

2475 M. Wilson, Wellington Street, Southwark—Bird cages
2476 J. J. E. Mayall, Brighton—Obtaining motive power
2477 W. Campion, Nottingham—Sewing machines
2478 A. Gilchrist, Glasgow—Slide valves
2479 H. N. Moyon and J. E. Lemereier, Paris—Machinery for the manufacture of coverings for the feet
2480 W. N. Hutchinson, Wellesbourne, Bideford—Improvements in locomotive engines and all descriptions of railway carriages, also in the form of rail on which the carriages run
2481 J. Blakey, Leeds—Utilizing waste leather
2482 F. Braby, Euston Road—Manufacture of caustic ammonia and ammoniacal salts
2483 W. Jones, Guide Bridge, Lancaster—Sewing machines
2484 S. Robinson, Dublin—Glass houses
2485 J. Jones, South Lambeth Road—Apparatus for applying electro-magnetism as a motive power to carriages, boats, and machinery
2486 W. R. Lake, Southampton Buildings—Screw propellers.—A com.

*20th August* 1869.

2487 W. S. Sutherland, Liverpool—Welding or uniting plates, tubes, and other forms of iron or steel
2488 A. Wigzell, Sowerby, near Halifax—Steam boilers
2489 W. Longbottom, Barnsley, and A. Willan, Harrowgate—Velocipedes
2490 W. Byrne, Belfast—Distilling alcoholic liquors
2491 H. J. H. King, Glasgow—Apparatus for measuring, indicating, and regulating the flow or passage of liquids
2492 L. B. Fortin, Paris, and J. Ferrabee, Brimscombe, near Stroud—Machinery for the manufacture of hats for felting &c.
2493 A. V. Newton, Chancery Lane—Manufacturing paint.—A com.

*21st August* 1869.

2494 W. Allan, W. Payne and A. B. Fraser, Liverpool—Apparatus for extinguishing fires in the holds or below decks of navigable vessels
2495 A. Neill, Bradford—Apparatus for cutting and dressing or producing an even surface on stone, marble, slate &c.
2496 G. W. Morgan, George Yard, Great Dover Street—Life buoys
2497 J. Barlow, Bolton—Manufacture of toilet quilts, table-covers &c.
2498 F. Coote, Charlotte Street, Fitzroy Square, and F. W. Cranch, Drummond Street, Euston Square—Velocipedes
2499 A. M. Clark, Chancery Lane—Springs for wheeled vehicles.—A com.
2500 P. A. Blake, Highbury—Safety explosive compound
2501 J. Baur, New York, U.S.—Manufacture of steel

*23rd August* 1869.

2502 H. Henchman, Bromley, Kent—Windmills
2503 T. Gibb and C. Geltstharp, Jarrow-on-Tyne—Extraction of copper from its ores
2504 N. Delandtsheer, Malines, Belgium—Combing machines
2505 H. A. Bonneville, Paris—Machinery for carding and combing wool &c.—A com.
2506 L. D. Girard, Paris—Improvements in railways and in railway rolling stock
2507 T. Whitehead, Holbeck, Leeds, York—Shackle and roller end for hardening machines for felting
2508 W. R. Lake, Southampton Buildings—Apparatus for raising and forcing water and for obtaining motive-power.—A com.
2509 W. R. Lake, Southampton Buildings—Posts or standards for gas lamps.—A com.
2510 J. H. Johnson, Lincoln's Inn Fields—Producing imitations of and substitutes for wood, ivory, stone &c.—A com.

*24th August* 1869.

2511 J. Frengley, Dublin—Tell-tale clock
2512 Z. Colburn, Bedford Street—Construction and mode of launching subaqueous ways
2513 J. Williams, Liverpool—Breech-loading fire-arms &c.
2514 H. Taylor, Kensington—Velocipedes
2515 F. Oakley, Toronto, Canada—Holding firmly and securely in their place bolt nuts
2516 J. E. Hodgkin, Liverpool—Machinery for breaking the woody parts of flax, straw &c.
2517 T. Briggs, Manchester—Machinery for spinning and doubling cotton
2518 J. D. Nietscke, Somerset, Ohio, U.S.—Preserving dead bodies
2519 J. Valters, Great Dunmow, Essex—Fining and clarifying ale &c.
2520 T. Webb, Bow—Ventilation of mines

*25th August* 1869.

2521 W. J. Cockburn-Muir, Westminster—Permanent way of railways
2522 R. Maynard, Whittlesford, Cambridge—Portable chaff-cutting machines
2523 C. Mackay and T. K. Wheeler, jun., Belfast—Cops for wefting and warping purposes
2524 T. Shakespear and G. Illston, Birmingham—Sewing machines
2525 O. and F. H. Varley, Stonecutter Street, Farringdon Street—Instruments for transmitting and recording electric signals
2526 C. Cérisier, Mung-sur-Loire, France—A system of ventilation and airing of millstones
2527 T. Coley, Maidstone—Cultivation of hops
2528 W. R. Lake, Southampton Buildings—Braiding or platting machines.—A com.
2529 H. Call, Concord, New Hampshire, U.S.—Obtaining and applying motive power
2530 G. Zoch and A. Lehmann, Havre, France—Manufacturing yeast or artificial ferment
2531 A. F. Cederwaller, Viborg, Finland, and A. F. Westerlund, Stockholm, Sweden—Improvements of the porcelain-faience and pottery manufactory
2532 W. Brown, Portsmouth—Constructing and disposing ships' cabins to prevent sea-sickness

# LIQUID FUEL BURNING APPARATUS.

HOMER TAYLOR, MONTREAL.
PATENTEE.



*Fig. 1.*

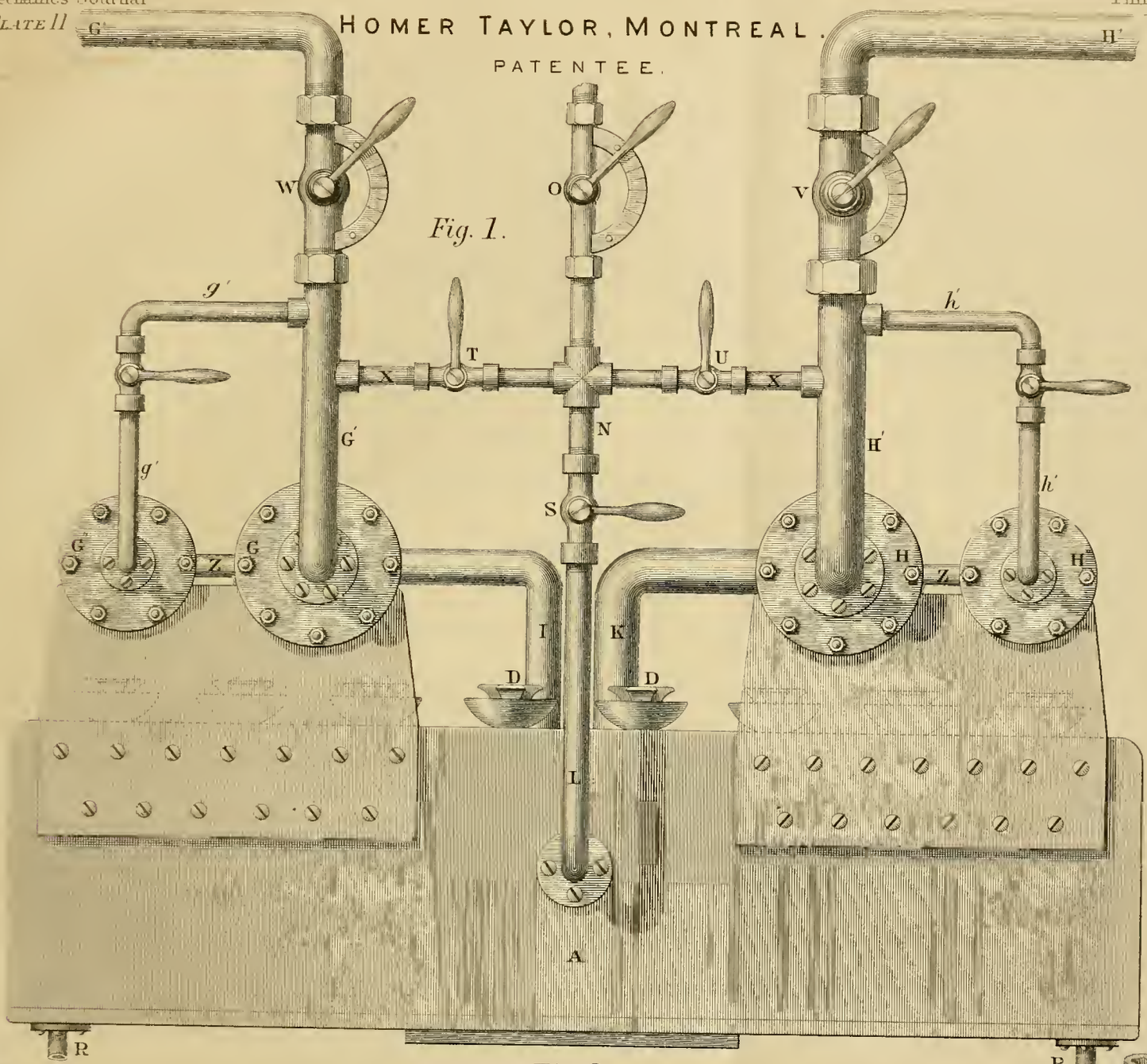
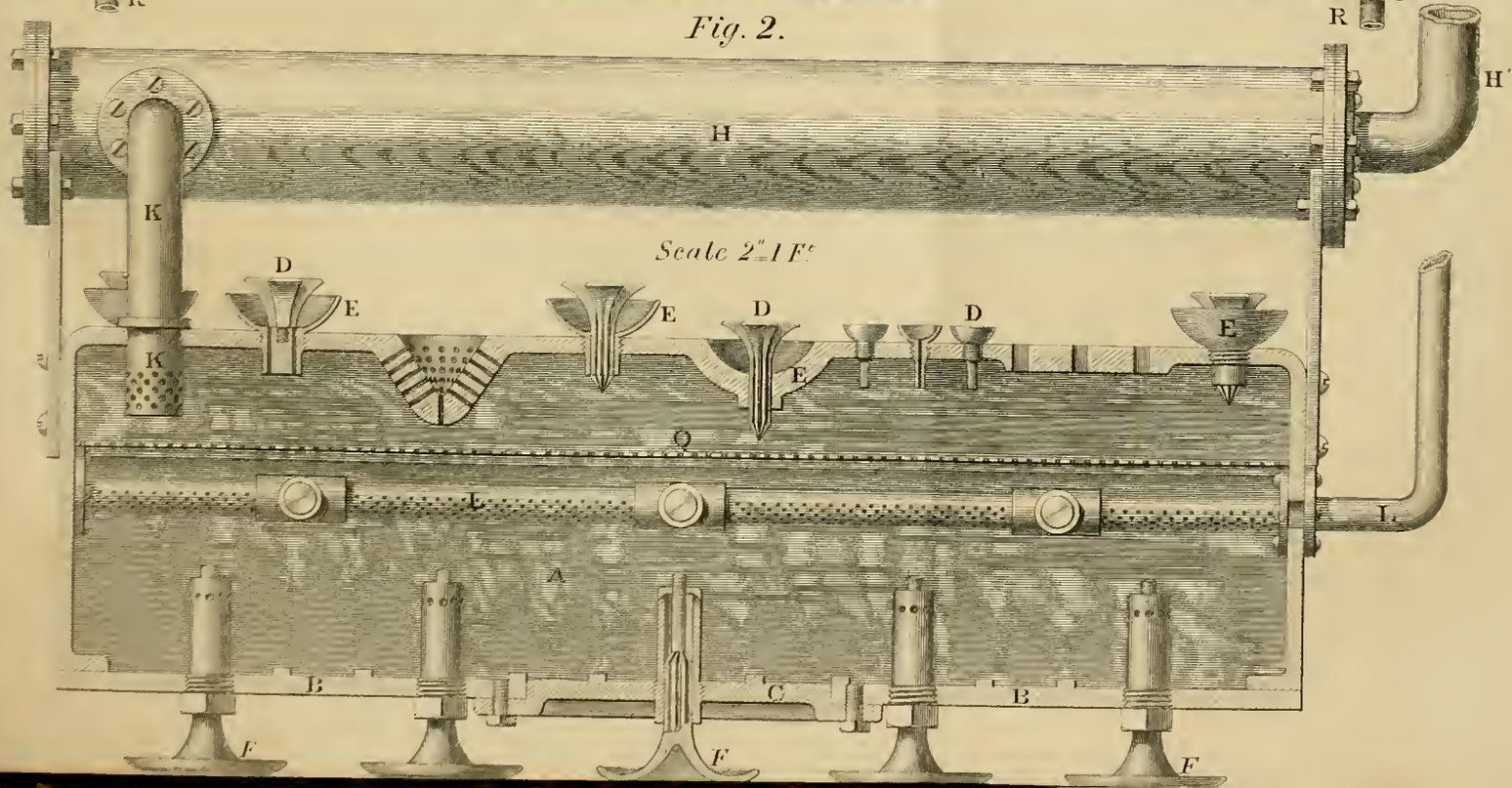



*Fig. 2.*



## LIQUID FUEL BURNING APPARATUS.

*(Illustrated by Plate XI.)*

THE subject of liquid fuel burning for generating steam and other heating purposes has, during the last few years, attracted considerable attention on the part of the engineering profession, and, as a natural consequence, many schemes more or less feasible have been introduced with a view to practically solving the problem of burning liquid fuel in a simple, efficient, and economical manner. Mr. Homer Taylor, a builder of Montreal, has recently patented in the United States of America, and in this country, some arrangements for burning petroleum, which we understand have been found to answer satisfactorily in America, and which will probably ere long be tried here.

Our plate engraving for this month illustrates Mr. Taylor's apparatus as adapted for steam-generators. Fig. 1 is a front elevation of the apparatus, and fig. 2 is a vertical section of the same taken near the centre of fig. 1; A A is a gas-generator or receiver, the bottom B of which is provided with a manhole C; D is a series of upper gas-jets or burners fitted into the top of the generator, one form of burner being shown separately on an enlarged scale at fig. 1 of the woodcuts; E are reverberating cups surrounding the burners; F are the lower burners fitted into the bottom of the gas-generator in order to heat the same, and so vaporise the oil therein; G represents a chamber for super-heating steam, which is used with the gas; and H represents another chamber for heating atmospheric air, which may be used either separately, or in conjunction with the steam. These steam and air heating chambers G and H are heated by the flame-jets from the upper set of burners D. In some cases, the same pipes and chambers will serve either for steam, or air, or both combined; I is the pipe by which the super-heated steam enters the gas-generator; K is the entrance for the air; and L is the entrance-pipe for the petroleum or other liquid hydrocarbon. The super-heating chamber G is connected with a boiler or other source of steam, by a metal-pipe G′ provided with suitable valves or cocks, and the air-chamber H is connected, in like manner, by the pipe H′ to any convenient air-forcing apparatus. The perforated inlet-pipe L for the petroleum having as many perforated branches inside the gas-generator as may be required, is connected with the oil-reservoir by the upright pipe N, and the flow of the oil is controlled by the graduated stop-cock O.

Fig. 1.

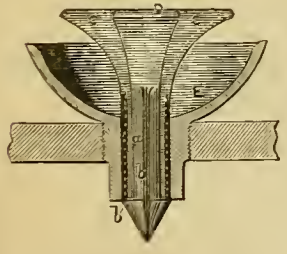
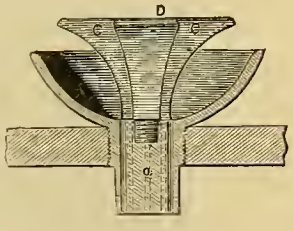


Fig. 2.

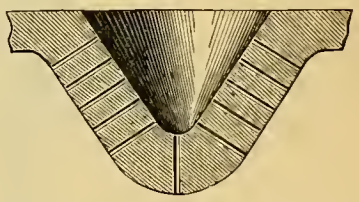


The petroleum reservoir being placed in the most convenient position near the apparatus, and all care being taken for its safety, the pipe communicating therewith is carried through the gas-generator, which, when applied to the generation of steam, is placed inside the fire-box or furnace-chamber. This pipe and its several perforated branches distribute the oil uniformly over the corrugated bottom of the generator. In order to prevent waves of unmixed steam or gas from reaching the burners, a perforated diaphragm or horizontal division-plate Q, of iron or other metal, is fitted inside the generator, through which the gas and steam must pass before reaching the jet-holes or burners in the top plate, thus ensuring the perfect admixture of the same. The upper burners or jets D consist each of a cylinder *a* of suitable size and length, having fine longitudinal grooves *b* cut in its surface, so as to form jets or gas-passages, as seen at fig. 1 of the woodcuts. A branched or expanded head *c* is also provided, which tends to spread the flame and promote combustion. These burners are placed in reverberating cups E for the purpose of concentrating the heat, and so obtaining a high temperature at the point of ignition, whereby the deposit of carbon in the jet-holes is prevented. Fig. 2 of the woodcuts represents another modification of the upper burners, wherein the grooved cylinder is replaced by a perforated cylinder *a*, with the branched head or deflector *c* screwed into the top. Any number of jet-holes may be used in each burner, from a single one (as shown at fig. 3) upwards.

Perforated sunk cones (fig. 4), or slits made in the top of the generator itself, or other suitably-shaped burners, may be employed, all of which, including the reverberating cups E (as shown in fig. 5), may be partially or wholly sunk into the body of the gas-generator. R R are pipes for drawing off any superfluous oil which may be contained in the gas-generator. The lower burners F F (shown on enlarged scale at fig. 6) are formed so as to turn the flame upwards to the bottom of the gas-generator, and to act as reverberators to the point of ignition. They may be held in place by being screwed in to the end of the tube *d*, or otherwise secured thereto, the tube *d* being perforated at its upper end to admit the gas to the jet-holes. These lower burners may be made with grooved cylinders or with perforated ones, as before described.

Fig. 3.

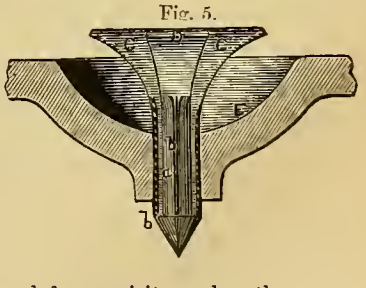
Fig. 4.



It is well known that if the gases be subjected to the slightest cooling influence, by passing through pipes to the burners or otherwise, they will decompose and deposit their heaviest ingredient, namely, carbon, in the pipes and jet-holes, which carbon in time, by becoming solidified, chokes them up.

It is, therefore, indispensable that all those parts with which the gases come in contact should be maintained at a temperature at least as high as that of the gases themselves. The mode of effecting this consists in projecting the burners into the body of the gas-generator itself, instead of carrying the gases in pipes outside the generator to the burners; consequently, the burners are maintained at a temperature as high as the gases by which they are surrounded, and by the action of the reverberating cups E on the burners their temperature is still further increased and all tendency to decomposition of the gases is avoided; the passages, moreover, are kept clear, and the gases are completely consumed. The bottom or heating-plate B of the gas-generator is corrugated, grooved, or otherwise divided by raised ribs into square, circular, polygonal, or other suitable forms, the object of which arrangement is to retain the oil as uniformly as possible over the whole surface of the bottom, since the apparatus would be continually changing its level when in use in locomotives or steamers. The operation of this apparatus is as follows:

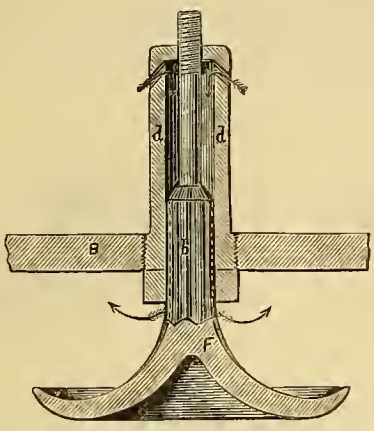
Fig. 5.



An external and temporary source of heat, consisting of a small fire or flame, produced from spirits or by other means, is required at the beginning of the operation in order to heat the gas-generator, after which a supply of oil is turned on by opening the graduated stop-cock O as well as the lower one S, the cocks T and U being shut. The oil is conveyed into the generator at L and distributed by the perforations over the bottom plate B, where it is vaporised by the heat of the bottom plate. Then, by opening the graduated cock V, the air is admitted from the forcing apparatus into the air-heating chamber H, passing thence into the gas-generator by the pipe K, where it mixes with the gas and supplies the upper and lower burners, which may then be lighted and the

temporary fire be dispensed with. The process may be continued thus with oil and air alone until steam can be obtained from the boiler; or, if preferred, a small detached boiler may be used for generating steam at starting. The steam may also be then turned on by opening the cock W, which admits it into the steam super-heating chamber G, whence it passes into the gas-generator through the pipe I; the proportions of oil, steam, and air being regulated by graduated indicator cocks as shown. The apparatus will now be in full action. The graduated dial-plates or indicators in connection with the stop-cocks of the oil, steam, and air are employed in order that the exact proportion of oxygen may be adjusted and supplied to the hydrocarbon gas, so as to form chemical union or perfect combustion without depending on the judgment of the person in charge of the apparatus when changing the volume of flame

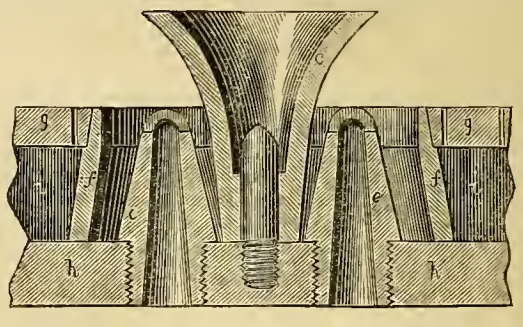
Fig. 6.]




or heat to any grade of its power, from the minimum to the maximum inclusive. According to another arrangement the lower burners F may be dispensed with and the oil be vaporised in one or both of the super-heating chambers G and H as follows :—After the gas-generator has been heated by the temporary fire, and the process continued until steam can be had from the boiler and turned on as described, the oil-pipe may be connected with the steam and air pipes through the branches X by opening one or both of the cocks T and U and shutting the cock S. The oil is then conveyed to the super-heating chambers G H by the steam and air pipes G′ H′, which are carried into the chambers a short distance. The pressure of the steam and air force into and distribute the oil in these highly-heated chambers, where it is vaporised and the gas carried into the receiver or gasometer A along with the steam and air. Or the oil-pipe may pass directly into or through the super-heating chambers, a number of perforations being made in such pipe in order to distribute the oil uniformly in such chambers. This oil is vaporised by the heat of the chambers and of the steam and air therein, and is passed to the gasometer or receiver A, as previously described, along with the super-heated steam and air. In some cases two or more super-heating chambers are used, as shown at G G″ and H H″, the extra chambers G″ and H″ being connected with the main steam and air pipes G′ and H′ by the branch-pipes $g'$ $h'$ provided with cocks; by using which the exact required quantity of the graduated supply having been forced into the larger chambers G H, the remainder, after passing through the smaller super-heating chambers G″ H″, enters the gasometer by the pipes Z and Z′.

By another modification the ordinary illuminating gas-burner of enlarged size may be used as shown in sectional elevation, and plan at $e$ $e$ in figs. 7 and 8, or other burners of suitable shape may be employed: any number of burners from one upwards are enclosed in a metal ring $f$, over which rings there is placed a cover of metal $g$ extending over the whole surface of the top $h$ of the gasometer or gas-generator, such cover having openings corresponding with the rings of burners for the issue of the flame. As many rings or nests of burners may be placed in the top $h$ as may be found requisite. The cover $g$ may be fitted on either in one piece or in sections properly secured. Its entire surface is perforated with a number of small holes as shown, and a space $i$ of about one inch in depth is left between the top $h$ of the receiver or generator and the cover $g$. Into this space one or more jets of super-heated steam or heated air, or both, are introduced, which being prevented from reaching the burner by reason of the rings surrounding them, are forced through the small perforations in the cover $g$ and ascend with the flame; thereby bringing the oxygen of the steam into direct contact with every portion of the flame, and thus supplying with oxygen any portion of the hydrocarbon that has not previously received its

Fig. 7.

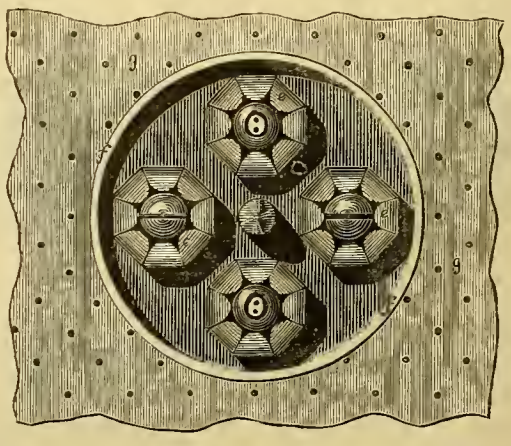



equivalent, besides supplementing the hydrocarbon with the hydrogen of the steam and reducing the expenditure of the fuel.

A conical metal deflector $c$ is placed in the centre of the ring or nest of burners in order to promote the combustion of the gases, such deflector being kept in place by a metal pin, or otherwise.

The reverberating cups E, before referred to, may be dispensed with in some cases, if desired. They may be made of metal, burned fire-clay, soap-stone, or other fire-resisting substances. Reverberating cups, cones, blocks or plates may also be used over or amongst the flames generated by the apparatus, if desired. Other modes may also be used of vaporising the oil than those already described. Thus, the oil may be carried by a pipe not perforated through the super-heating chambers, and delivered to the gasometer or generator in a highly-heated state, wherein vaporisation is completed by the action of the steam and air.

Fig. 8.




Another mode of vaporising the oil consists in passing the waste heat or products of combustion through a flue passing under and around the gas-generator before its final exit to the chimney, by which means the generator is sufficiently heated to vaporise the oil. Or the petroleum or the heavier hydrocarbons are heated by a coil of piping, or by a suitable vessel or chamber placed in the smoke-box, and the oil, after being heated, is carried by a pipe to the generator, or it may first pass through the super-heating chambers before reaching the generator. The air and steam employed may in some cases be heated partially or fully by means of the waste heat, as described for the petroleum. The steam and air may be used either conjointly or separately in one or all of the

super-heating chambers, and with or without the oil in any of them.

The supply of steam has hitherto been described as being obtained direct from the boiler; but, in the majority of cases, it is preferred to use the exhaust or waste steam from the cylinder of a steam-engine in order to utilise the heat contained in such steam, and to avoid overtaxing the boiler.

With a view to economising oil when the engines are stopped for any short period, it is proposed to employ an arrangement whereby all the burners on the top of the gas-generator or receiver may be shut off, except those situate underneath the super-heaters for the steam or air; by which means the super-heaters will be maintained at the proper temperature by the expenditure of a comparatively small quantity of oil, and will be always ready for instantaneous resumption of work.

## MR. MACFIE, M.P., AND PATENTS FOR INVENTIONS.

THE late Session of Parliament has not only become notorious for passing into law one of the most sweeping measures which has at any time fallen to the lot of British legislators to deal with—one over which the bitterest irony and sharpest contention were witnessed in both Lords and Commons—but it was also made the arena of attack, upon what is in its essence or principle very rightly regarded by all except a not numerous and prejudiced few, as a protective system, which on several grounds is, indeed, worthy of being cherished; and that, not merely on account of the indisputable *prestige* which to us as a nation the influence thus obtained has secured—we allude to "Patents for Inventions."

On May the 28th, a few honourable members spoke out their convictions, in following up the speech of Mr. R. A. Macfie, M.P. for Leith, who, in the course of his remarks, put the following motion to the House:—

> "That, in the opinion of this House, the time has arrived when the interests of trade and commerce, and the progress of arts and sciences in this country would be promoted by the abolition of Patents for Inventions."

It is almost needless to say that the motion was distinctly negatived by the House, and the abolitionist party were very plainly informed by the Attorney-General to the effect that, although the ministers of the Crown (after the disposal of certain other measures, which at the present time press heavily on their attention) were quite ready to consider a measure for the amendment of the present laws, yet they were very far from being prepared to sanction a wholesale wiping out of the patent system.

Notwithstanding the opposition to the motion shown by all except a few members of the House of Commons (Sir Roundell Palmer and Lord Stanley), and the very decided expression against the attempt of the abolitionist party, the country is now threatened with the semblance as if of a deeply significant power, that the same, or a similar onset, is to be made during the next session.

Inventors and others—nay, the interests of the nation itself, which are by far more seriously to be weighed than individual claims—all, singly and collectively, now demand their cause to be heard in face of the combat ere long to be fought out.

That the patent laws are at present in an unsatisfactory condition no one, we presume, will pretend to dispute; but that they cannot be amended and placed on an equitable basis, by which justice shall be administered to the deserving inventor in return for the benefits which he may confer, and to the nation in return for granting him the exclusive control of it for a certain number of years, only a very few will attempt to deny.

It is perhaps noteworthy and much to be regretted that, in a country where so large a number of patents for inventions are annually granted, the true spirit of these grants is appreciated by at most a very few—indeed, the recent treatment of the subject by Mr. Macfie, as well as by some of the speakers on the occasion before alluded to, displayed a most remarkable necessity for a better understanding of the matter which each set himself to deal with.

Not contented with bringing forward one of the boldest and most one-sided proposals that the House of Commons has for a long time had presented to it, Mr. Macfie has since ventilated in a small volume * his strange, impolitic notions as to what he endeavours to make out as the "natural right" of the public to everyone's ideas without price. As the volume may safely be taken to contain the quintessence of those views upon which the abolitionist party propose their attack upon what the author is pleased to style "the last stronghold of monopoly," it will be expected by the readers of a journal which professes as one of its features the advocacy of national progress, the rights of inventors and patentees, as well as the promotion of improvements in the laws by which these are governed, that paltry, ill-conceived, and aërial as are the flights of imagination promulgated in these 342 pages, they should be by us considered, not *ex necessitate* of opposing a counter argument to *quasi* powerful logical deductions, but merely to show up the inconsistency and flimsy character of the arguments employed—for otherwise the nature of this new opposition to the granting of patents is too trivial to spend much space in commenting on.

Mr. Macfie's volume opens with a prefatory letter of Professor Thorold Rogers, from which we make the following quotations:—"The present machinery (patent system) gives the minimum advantage to the inventor, and inflicts the maximum disadvantage on the public." Now, in the first place, we humbly ask Professor Rogers under what standard he estimates the inventor's maximum advantage? The only real test of the value of an invention, which is practically of any weight, is the use made of it by the public; and in those cases, where a patentee reaps either insufficient or no reward, it must be due to one of three causes: either that the public do not require the invention; that the patentee has not used sufficient exertions to introduce it, either by making public in a sufficiently demonstrable manner the advantage that would be obtained by its adoption, and by using suitable means to overcome existing prejudice; or, that the subject-matter of the patent is impracticable, or no improvement upon what already exists, and is, therefore, useless. With all kinds of property we presume that possession is the prime element requisite to secure the maximum advantage to anyone; how then is it that the possession of a patented invention differs so largely from other kinds of possession, that the element which secures the maximum in one case, produces a minimum advantage in the other? By being allowed to appropriate his invention, the inventor is enabled to do with it as he would with any other kind of property—namely, make the most of it during the period over which he is allowed full control; and this he does by making the invention public, taking in return, as his reward, the price the public consents to pay for it, which is precisely the return every other owner of property obtains; for be he a landowner, householder, shareholder, or what else, the return he gets is the maximum the public consents to pay him for the use of that which he possesses. We also desire to know how it is that the system "inflicts the maximum disadvantage on the public." The public is precisely its own controller in such a case, for if it elects *not* to pay for that which it may employ if it chooses, then the patented invention can have no effect on the public; if, on the other hand, the public does consent to pay for the use of any patented invention, no further proof is wanted to show that the employment of the invention at the price paid for it must have a greater advantage than by working under a process or system, or with the mechanism which pre-existed. It is not because inventors obtain patents that the public consents to employ the inventions; but, because the public reaps benefit in some one of various ways by using the invention at the price paid for it.

A favourite cry of the abolitionist party is the interference with and obstruction to trade of patents. Yet how futile is the assertion—for merely an assertion, hollow and false, is it—as surely, if a patent interfere, the manufacturers and traders need not use it; and, we ask, would any one use it if by his existing methods of working he could reap so large an advantage as would accrue to him provided he paid the price charged for the patented means or methods? The very fact of a patent being adopted is proof of its advantage. That there are many obstructive patents we freely admit, and such there will ever be, until a proper system of scrutiny is established so that every specification of a patent shall be subject

* *Recent Discussions on the Abolition of Patents for Inventions in the United Kingdom, France, Germany, and the Netherlands.* By R. A. Macfie, M.P. London: Longmans, Green, Reader, and Dyer. 1869. Pp. 342.

to rigid examination before the patent is allowed; yet the existence of these is no argument against the policy of a properly administered system of protection for inventions.

We should fully understand Professor Rogers' assertion that the patent system is productive of a maximum disadvantage to the public, if we were to admit with him the nonsense as to "natural rights," which Mr. Macfie has preached, and which the Professor homologates, the meaning of which is that, according to natural law, an individual has no right to claim property in the result of his ideas, which the abolitiouists declare may occur to any number of men, not even when, as is often the case, a whole lifetime and fortune have been spent in producing a result which is of such benefit to his fellow-man—no ! but that his fellow-men may take it and enjoy it to any extent they choose. Such a use, we presume, would be, according to the abolitionists' view, conferring the maximum advantage on the public, yet all the while they say the inventor is not to go unrewarded, and propose to leave it in the hands of the State, to give him what it chooses from the Treasury, or by handsomely awarding a medal or honourable mention upon his placing the invention before it, or of refusing him any award whatever if it considered the invention as undeserving.

Almost useless is it to remark as to the impossibility of estimating what reward, if any, is due to an inventor, until his invention has had a long trial; indeed those who have any experience of the working of inventions, know well that numerous proposals which at first sight are most unpromising, turn out of great practical value to manufacturers and others—whilst others, which at first promise much, are practically valueless. How then is the State to devise judges for settling the amount of reward to be paid to an inventor ? We altogether fail to see by what other means either the inventor or the nation may mutually reap so large an advantage as by the granting of patents.

The abolitionists urge as another powerful objection, that patents ought not to be granted because it enables the patentee to oppose trade, either by the demand of excessive royalties, or by confining the use of the patent to himself if he likes to do so. Now the first part of the argument is easily disposed of ; for if, as is usually the case, the patentee's object is, amongst other matters, to reap reward by the granting of licences, he knows his interest too well to charge too high a royalty ; if on the other hand he has discovered a means by which he can carry on his manufacture more advantageously, that is, more economically than hitherto, is he not in strict justice entitled to confine the use of his invention to whom he chooses, unless he be adequately compensated for extending its use generally ; and in this way to reap reward for his discovery ? Oh ! no, the abolitionists declare, because it gives to him a certain, an undue advantage over his neighbours, and therefore he has no exclusive right to it. Yet we ask how these men would deal in any other case when any one has been fortunate enough to make a discovery of another kind. For instance, in the search for minerals, which in the nature of things anyone might discover if he sought for them, is the finder to be deprived of making the best he can in return for the labour, time, and means he has expended in "prospecting," and then hand the discovery over to the nation, because any one or more of its number might, according to the human constitution and mind, have found out the same if he or they had been set in the same track ? A more ill-judged scheme of Chartism has never been before set open to the British public ; for in the same treacherous pitfal, the whole system of mercantile gain might as well be proposed to be abolished.

Professor Rogers further says, that in "*ninety-nine cases out of a hundred*, the patentee is only a simultaneous inventor with a number of others, who lose their labour and ingenuity because one man happens to get in first."* This extract is perhaps all that is necessary to show the ill-considered conclusions of the abolitionist party. Where are the proofs that in "*ninety-nine cases out of every hundred* the patentee is only a simultaneous inventor with others ?" At this place it is sufficient to contradict the assertion, as being wholly untrue; so palpably false indeed, that no argument is needed to support our contradiction. That it sometimes happens that a similar result is elaborated by more than one individual, is perfectly true, and sometimes simultaneously: this is only the natural result of a public's demand for something which it does not already possess as readily as it desires, or that which already exists does not suit the public taste, or that something totally new is asked for—but in this as in every other mode of meeting a public want, why is not the man of greatest enterprise, he who is foremost in the race, to reap the greatest benefit, which, as in every other transaction or pursuit, is what all who work at it labour after ? Where there is a prize to be won, surely it is due to him who first fulfils the conditions on which it is to be possessed.

The abolitionists further endeavour to show that, by granting a patent, which confers a right on one person, it is inflicting a wrong on others, yet where is the tenability of such a dogma,—when it rests in nearly every case with "the others," whether the "right" conferred is of value or not ?—and hence they proceed to distinguish between invention-right, and copyright ; for, say they, or rather Mr. Macfie says for them, "those things that belong to the province of patent right are in their nature *capable** of being independently discovered or originated in the same identical form by a plurality of persons." We do not deny that it may be "capable" for several men to aim at the same result, when prosecuting a similar line of inquiry or desiring to obtain one and the same end; yet if the British nation is to legislate on what is *capable* and in preference to dealing with the facts and circumstances that *are*, why then the sooner we bid adieu to providing for existing necessities and work upon pure hypothesis, so much the more readily should we answer this hue-and-cry for patent abolition.

And further—"Of this character are the principles of mechanism, processes of manufacture, and forms or methods accordant thereto . .

"It is otherwise with things that belong to the province of copyright, literary or artistic combinations, books, pictures, musical compositions, involving any degree of elaboration. Such at no interval of time have ever been produced by even one other person except a copyist."

Does Mr. Macfie require to be informed that "the principles of mechanism" do not constitute a subject-matter of patent right ; is he further so blinded, and unwilling to own the truth that in almost every case of infringement the infringer is a copyist or at best makes an attempt to evade the right of another ? He says, "to infringe copyright means to slavishly or meanly copy the work of another." We ask, what may be said of almost every case of infringement of patent right ? We must deal here with those stubborn realities, facts, not with *quasi* "natural" hypotheses.

(*To be continued.*)

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## A RECENT VISIT TO THE ASPHALTE MINES AND WORKS OF PYRIMONT, SAVOY.

(*The Manufacture.*)

It is not a little curious how little is commonly known in Great Britain of the Asphalte industry of France—one thought so important abroad, and to which we are indebted for whatever asphalte is employed by engineers or architects in our own country. It is equally remarkable how much more largely and universally asphalte is employed on the Continent than it is with us; though there, as here, it competes with artificial—so-called asphalte—made from coal-tar or its distillation educts, mixed with sand, clay, lime &c. Chemically this artificial asphalte may not quite improperly

* The extravagance of this has only been equalled, if surpassed, by Mr. Scott Russell, who in his evidence before the Royal Commission, in 1863, exposed himself to the ridicule due to saying, that " Members of this Commission can answer how many inventions there are for putting weight at a greater distance from the centre, so as to produce something equivalent to creating a power; *it is well known that there are hundreds of these inventions* (for perpetual motion) *every day*, and it would be the greatest blessing in the world to an inventor of that class to stop him in his career." On this Mr. Dircks, in his instructive and useful volume, *Inventors and Inventions*, has remarked, " Hnndreds every day would amount to something like 30,000 annually ; the worthless labours of inventors, whom it might indeed be well to save from ruin to themselves and ruin to others by their overflowing bad example. But such is *not* the fact; there are *not a dozen* patents on that subject in a year." Pp. 12-13.

* The italics are ours.

take its title, but its physical properties as a cement or a covering are very different from those of the natural asphalte, and, in certain respects, very inferior.

For mere water-staunch coverings there is no question but that the coal-tar asphalte may, by proper management, be made to answer perfectly; and even as a covering for foot-ways, the experience of many of the *trottoirs* of Paris proves that in skilled and careful hands it can be so laid as to be moderately resistant of strong sun heat, and perfectly so of moisture, and, therefore, of frost.

But even when laid with the utmost skill, it *does* more or less soften with the sun, and the foot leaves its impression if the surfac be stood upon without motion for a few seconds. Whilst badly prepared—*i.e.* with any excess of coal-tar—or with the earthy material badly diffused and incorporated, foot-ways of this artificial asphalte get perfectly sticky, and even half liquid here and there; and "blow-holes" of vapour of some volatile coal-oils open here and there, which afterwards permits the entrance of water, and the next hard frost splits up more or less the adjacent surface. No more valuable or suitable use for this artificial asphalte has been indicated than that so largely found for it in Manchester and Liverpool, *viz.* for the cementing together of granite pavement for the streets. It is strange that this employment for it has been so little noticed in London, where we would commend its extension. This great difference between the physical properties as a constructive material of the artificial asphalte, and the natural asphalte of Seyssel or Pyrimont, arises really not so much, if at all, from any differences in the chemical properties of the bituminous matter in each respectively, as to the *state in which* it is combined by mixture with the solid matters in the two cases.

Natural asphalte, more or less like that of Seyssel and Pyrimont, is found in many parts of the world, and in rocks of several different ages or formations, but most usually the rock in which the asphaltic beds are found is calcareous. It is so at Seyssel and Pyrimont; the mines at which places, on the right bank of the Rhone, between Bellegarde (the frontier fortress of France) and Culoz, about an hour-and-a-half by rail from Geneva, are situated in the Jura limestone.

When the Pyrimont station is reached, close to the grand sweeping current of the united Arve and Rhone, the asphalte works of Pyrimont, the property of Monsieur de Malo, are seen close to the river brink, and a short but steep walk, after crossing the railway, brings us up to the nearest of the many asphalte workings which supply the works. Asphalte is brought to them also from more distant parts of Savoy (still in the Jurassic limestone formation or in the "Molasse") by barges across and a little down the river, as also to Seyssel, which is a few miles lower down the Rhone upon the same bank, and whose natural mineral riches and manufactured material are identical almost with those of Pyrimont.

The land here slopes rapidly from a sort of rolling and rather inclined mountain table to the south-east of the Jura chain, and from four to six hundred feet above the Rhone, down to the river's brink. Climbing about 300 feet up this steep from the railway, we arrive at the first excavated face of rock, from out of which the asphalte has been extracted, and from which much more remains to be got out. There are horizontal galleries lower down, nearly on the level of the rails, from which asphalte is also obtained, the beds to which these lead being deeper in the rock.

The asphalte-bearing bed (at the upper workings, which are partly open to the day—a sort of quarry of limited height, with the heavy cap of covering rock not removed) is from 5 to 8 or 10 feet in thickness, nearly continuous, but very irregular, both in thickness, richness, and form, and, commonly, with very ill-defined boundaries, at the upper or roof side of the seam at least.

The formation of calcareous rock, known as the Jurassic, from the characteristic they afford of the material of the irregular range of mountains stretching along to the north and north-west of the Lake of Geneva, and called *in globo* the Jura—though one long mountain alone, properly bears that name—consists of a vast variety of calcareous materials, from incoherent marls and hard limestones of nearly pure carbonate of lime, to sandy marls and limestones, loose sands with more or less calcareous dust or mud mixed, and liassic limestones of variable hardness, but often very hard, and containing variable proportions of alumina, magnesia, and silica (in a soluble form), which produce in certain beds admirable hydraulic limes. These various qualities of limestone are in many places found mixed up together in a sort of discontinuous stratification, and in the most irregular way and forms; such is very much the case at these Pyrimont mines.

The main mass of the rock exposed, is of very variable petrological character, yielding more or less fat or non-hydraulic lime when burnt; but it contains with a rude irregular sort of discontinuous continuity three remarkable beds. The middle one of these, the asphalte, is the subject of our notice; above it *generally* (not always) is found a greenish-gray, soft marl, coherent but friable, and below it a seam, of variable thickness, of dense, close, fawn-coloured and gray liassic limestone.

The asphalte bed is of dark hue, varying from perfect blackness but without lustre, to a soft gray or yellowish-brown. It is in fact only a bed of porous limestone, very variably but most thoroughly impregnated naturally with bitumen. This latter can be completely washed out from pulverised specimens by means of sulphuret of carbon as a solvent, and the limestone then appears almost as white and soft and fine as powdered chalk. It is, in fact, almost chemically pure carbonate of lime, containing merely a trace of peroxide of iron, and appears to hold the water found in it merely in mechanical suspension.

The asphalte is worked on the plan called in coal-workings "pillar and stall," and is all taken out by blasting, the consumption of powder being, however, very trifling; when detached, its fracture is coarse, and generally earthy; the surface of fracture straight, or tending slightly to conchoidal. It is soft, so that one piece of asphalte leaves a large umber-brown streak when rubbed against the surface of another. It is neither sticky nor unctuous to the hand, but soils strongly, and exhales the peculiar smell which, once recognised, is not easily forgotten.

Occasionally, however, parts of the seam show glistening master joints and cross ones slimed with gluey asphalte; and now and then, though rarely, cavities are found in the rock more or less full of actual liquid asphalte. These indications occur wholly in the harder portions of the seam and in its lower portions.

We cannot in a notice, necessarily here too brief from want of space, enter upon the highly interesting and curious questions, as to the origin in the play of natural forces which have produced this valuable material, further than to say, that probably in every case the permeation of the porous rock, has been produced by natural distillation and sublimation of hydro-carbons pre-existing in other states more or less analogous to coal; the distillation having taken place, sealed up by heavy beds of superincumbent rock from access of air, the temperature being low, but the pressure of the evolved vapours and that under which condensation has occurred very great. During one of the most recent eruptions, that of 1862-3, of Vesuvius, which breaks through Apennine limestones—lithologically very much of the character of those of Jura—all the wells about Torre del Greco began to exhale the exact smell of Pyrimont asphalte when heated, and traces of bitumen were observed in films upon the surface of the water sources. There can be little doubt that here asphalte was either being formed from beds of lignite, which are frequent in the limestone of Italy, or that beds of asphalte, already so formed, were being once more exposed to heat and vaporisation.

The asphalte as extracted from the Pyrimont mines is passed down to the works by a double inclined tramway, the surface contour of which in section is a nearly exact parabola, the empty wagons being taken up by the descent of the full ones. The works for its preparation for market also lie upon a rapid slope, and advantage is taken of this form of the ground, so that the raw asphalte arriving first at the highest level passes down by its own gravity, as it also passes through each process, until, arrived at the bottom, it is ready for shipment on the river; that which is to be sent away by rail being hoisted up again, by the steam power of the works, to the level of the rails upon a short direct and steep tramway by means of a wire rope.

The asphalte of commerce occurs in two forms; 1st. The natural asphalte merely reduced to a coarse and uniform powder, about the size of mustard seeds, which is employed for laying floors, foot-

ways, streets &c., mixed or not with dry sand, or with sand and lime.

It is simply heated in cauldrons to about 250° Centigrade, spread out upon the prepared base or foundation, and beaten and consolidated with heavy instruments of cast-iron heated *nearly* to low redness.

Laid in this way the asphalte is *nearly* rain-proof, though not so, to even a small head of water, and is, when hardened, solid, firm, and coherent. The preparation at the outset, or first operation, is the same for this and for the second sort of asphalte, viz. that which is sold all over the world in round-shaped flat cakes or blocks, weighing about 100 pounds each, and which, when to be used, are quite melted up into a thick liquid like pitch, and in that state ladled out upon the prepared floor to the desired thickness, with or without admixture with sand, lime, or other pulverulent matter. In this state the consolidated asphalte is compact, water-tight under any head of water, harder than the former, rather more brittle in extreme cold, and rather softer in great sun heat.

The raw asphalte is powdered in mills driven by power which requires to be large from the toughness of the material. The mills are of various sorts ; edge stones, like those of common corn-mills, and heavy cast-iron sharp-toothed conical hopper mills, like our bark mills, or gigantic coffee-mills. Carr's patent centrifugal quartz-crushing, or rather breaking, machine, is now in process of erection and about to be tried for smashing up the larger lumps. The writer, however, does not anticipate any great success from its application to this rather tough material. No "stone-breaking machines" of the class now in such frequent use for crushing road metals and ores &c. are as yet employed.

A large train of lifting machinery, mainly consisting of revolving screens, succeeds the crushing machinery, and are chiefly employed for the asphalte to be laid dry as it is called, i.e. spread in powder. Separated into different finenesses and qualities, this powder is packed in casks for export.

For the manufacture of the fused cakes but little previous crushing is required. The natural asphalte cannot be melted as it comes from the rock, by any amount of heat applied with ordinary rapidity, without the destruction of a considerable portion of it. Indeed, heated *dry* it takes fire after evolving much gray blue smoke of asphaltic vapour, long before it shows any signs of melting, or even of softening.

The process, therefore, by which it is rendered a viscid liquid, is a double one, dependent partly on solution, partly on fusion, or perhaps it would be more correct to say that it is simply fusion aided by heat. The solvent employed is not the product of the Seyssel or Pyrimont mines, and is brought to the works from so distant a point as from near Autun in France. At Autun there is a vast manufacture of schale or schist oils, i.e. of various, more or less, volatile hydrocarbons, applied to several purposes in the arts as well as to illumination, procured by distillation from bituminous *schales* or *schists*, after the methods first successfully employed, if not first pointed out, by M. Selligues. In the refinement by fractional distillations of these crude schale oils, there remains a large amount of a peculiar viscid, but at any ordinary temperature more or less liquid, dark-coloured, and peculiar-smelling *schale or schist tar*.

This is the solvent employed for the Pyrimont asphalte. It is brought in casks (iron tank wagons would be much better) by rail, and at once started into a huge masonry tank for storage at the upper part of the works ; this is covered from rain.

Into deep rectangular boilers, each about 3 metres long, one or 1·2 metres wide, and two deep, is put a certain quantity of this schist tar ; a gentle heat is applied direct by coal fire to the whole range of these boilers, and when the tar boils slowly, an equal volume of the raw asphalte, in powder or small lumps (just as it comes), is added ; the heat is maintained for twelve hours, and at the end of that time the whole of the asphalte is found to have been dissolved and combined with the tar.

From the heterogeneous nature of the natural asphalte, however, as already described, many nodules, or portions of finer divided matter, do not dissolve at all, but remain incoherent in the bottom. This is little more than mere limestone, though penetrated, or, at least, coloured by asphalte, and externally black and covered with tar.

The boilers have perforated false bottoms, and cocks and mains by which, at this stage, the thick liquid matter is racked off from the undissolved residue, and is passed directly down below, without cooling, into another very large rectangular cauldron, in which the produce of the whole range above gets united. This is kept warm by coal fire heat. Out of this the now formed asphalte is laded by hand, by men naked to the waist, and put into buckets which hold just the right quantity. These are carried away by other gangs of equally stripped men, who fill out of these buckets the wrought-iron moulds, ranged upon the floor, in which the cakes of asphalte set hard, and removed from which they are ready for market.

The liquid asphalte is not to the eye even, a homogeneous fluid ; it looks, though at a low temperature in comparison, almost exactly like liquid trachytic, or certain basic sorts of lavas, which consist of a glossy slag, filled full of less fusible crystals, all flowing along together accordingly : except that it is intensely black and shining, this liquid asphalte looks very like very coarse oatmeal porridge, in which the grains of large meal are still quite discernible.

Each mould consists of a ring in two segments, each formed of flat bar-iron about 6 inches wide by $\frac{3}{4}$ in. thickness. To one of these inside is riveted a cast-iron plate with the name of the maker (Malo, Pyrimont) in relief upon it, so that the cake when hard shows this trade-mark in *intaglio*. The floor is of cast-iron plates, kept smeared with white clay and water, with which also the moulds are constantly kept coated. They simply *lie* upon the floor, and the two sedgments are heavy enough not to separate when filled. The buckets are, though kept hot, dipped into water each run, so that the asphalte parts cleanly from them. The filling and emptying goes on rapidly, so that eight men do the entire work of moulding of the concern, the machinery of which occupies an engine of 35-horse nominal power.

The men are powerful, but the labour is obviously severe, and not free from occasional danger of a burn. Besides the asphalte of his own mines, Monsieur de Malo now works up a large quantity of bitumen or asphalte from the Pitch Lake of Trinidad, which is at present imported largely into Marseilles.

It is to be regretted that our own manufacturers and organic chemists have as yet all but ignored that exhaustless source of bitumens of several sorts ; the more so as one of the most recent discoveries announced in the limitless field of organic chemistry is the production of *artificial alizarine* (a substitute for madder), from *anthracene* (paranaptaline), obtained by acting upon these very asphaltes of the Jura ; and that the Pitch Lake of Trinidad may yet be one of the greatest sources of colouring matter for the whole world, needs no stretch of imagination to foresee. As yet, neither at Pyrimont nor at Seyssel have any attempts been made to obtain any other products from the natural asphalte than we have above described ; perhaps a not unnatural consequence of a well-paying trade, which nature herself has made almost a monopoly.

Ed.

## DETERMINATION OF PHOSPHORUS IN SOILS, MINERALS, ASHES, AND MANURES.

By M. Schloessing.

Some months ago M. Henry Sainte-Claire-Deville presented to the Institute of France a communication from M. Schloessing on the determination of phosphoric acid in vegetable bodies, manures, and soils, which does not appear to have attracted the attention which the importance of the subject and its difficulty demand.

The author stated in a former communication (May 25, 1868) how he had been led to the determination of phosphoric acid in the ashes of vegetables, manures, and soils, by the transformation of the phosphates into phosphuret of iron, a process which M. Henry Sainte-Claire-Deville had first employed for his analysis of the mineral Bauxite ; and he had indicated a new method of determining phosphorus in the phosphuret thus obtained : he then pointed out a method for causing the whole of the phosphorus contained in a mineral to combine with iron.

When mixtures of elementary compounds, which represent by their proportions a clay, or any soil whatever, and to which is added

a known weight of a phosphate, are heated with a siliceous flux and oxide of iron to a white heat in a brasqued crucible, the whole of the phosphorus is generally not found in the fuzed matter. It is probable that, as the reduction of the oxide of iron has terminated with that of the phosphoric acid, the fuzed matter reunites in small lumps and in parts which go to the bottom as soon as the fluidity of the scoria permits, and the vapour of phosphorus, which is continually formed, and which is drawn away with the oxide of carbon, escapes from the crucible. This explanation had suggested to him the idea of using as a flux a silicate of iron in such proportion that, after the saturation of all the bases by its silica, there still should remain in the scoria an excess of silicate : this excess, continually exposed to the high temperature produced by the coal-gas blow-pipe, so long as any reduction of phosphoric acid goes on, constantly presents iron to the nascent phosphorus vapour. Experiment has confirmed this prediction.

The silicate of iron is easily prepared by melting in a brasqued crucible iron filings, peroxide of iron and pure sand, in the proportions of 28, 80, and 45. The melted matter, separated from the superabundant iron, is pulverized and sifted : its composition varies between $\frac{4}{3}$ and $\frac{5}{3}$ of Fe.O. to 1 of $SiO^2$. The substance, the object of the analysis, is mixed with this silicate and powdered retort-carbon : the proportion of the flux is calculated such that the scoria produced shall retain oxide of iron ; so that the carbon to be employed is about half that which is necessary for reducing the whole of the oxide of iron. Earthen crucibles are used, which are brasqued with a nearly dry paste of well-powdered retort-carbon and syrup, or molasses : a coat of three millimetres thickness is sufficient to make an actual charcoal crucible very solid, and such as shall keep sound, when the earthen crucible cracks and gets out of shape. Heat is applied during 5 or 6 minutes progressively, and then during 20 or 25 minutes with the full power of the blowpipe. With a given gas blowpipe and given size of crucible, it will be necessary to ascertain preliminarily whether in a crucible of equal size, filled with wrought-iron nails or rivets, their complete melting can be effected.

The scoria is crushed in an iron mortar, covered with a piece of caoutchouc. The ingot or bottom part of the fuzed mass and the metal are then separated, and the rest pulverized, mixed next with chlorate of potass, and put along with the rest into the tube where the separation of the phosphorus from the iron is to take place.

*Experimental Verifications.*

| I. | II. |
|---|---|
| 300 mg. phosphate of lime, containing 53 5 p. 100. Ph. Os. | 266 mg. another phosphate of lime, containing 50·2 p. 100. |
| 1200 mg. silicate of iron, and 300 carbon. | 1500 mg. silicate, and 200 of carbon. |
| 500 mg. filings of iron. | 700 mg. filings of iron. |

When a phosphate does not contain an excess of base, and when it, therefore, may lose phosphorus from the moment when it has acquired a bright red heat, and before the silicate gives up any reduced iron, the precaution is taken of mixing with the matter iron filings. The results obtained were :—

*Phosphoric Acid.*

| I. | II. |
|---|---|
| Found 160 mg. 8. | Found 112 mg. 7. |
| Calculated 160·5. | Calculated 113·4. |

With clays, or carbonate of lime, or mixtures of these two substances, the operation is performed by the addition of phosphoric acid in the form of phosphate of alumina in solution. The clay has been first moistened with nitric acid, put in suspension in a great volume of water, separated by decantation from the sandy parts, washed and dried.

*(Further Verification.)*

| Clay. | Carbonate of Lime. | Phosphor. Acid added. | Silicate of Iron. | Carbon. | Phosphoric Acid. Found. | Calculated. |
|---|---|---|---|---|---|---|
| 5 gr. | 0 gr. | 0 mg. | 5 gr. | 0·250 mg. | 6·1 mg. | mg. |
| 5 | 0 | 25·1 | 5 | 0·250 | 31·3 | (25·1 + 6·1)=31·2 |
| 5 | 1 | 25·1 | 5·5 | 0·320 | 30·7 | 31·2 |
| 5 | 3 | 25·1 | 7 | 0·420 | 30·5 | 31·2 |
| 2·5 | 2·5 | 25·1 | 6·5 | 0·390 | 28·5 | (25·1 + 3·05)=28·15 |
| 0 | 2·5 | 25·1 | 5 | 0·300 | 25·7 | 25·1 |

These assays have thus been conclusive enough to enable M. Schloessing to apply his process to the analysis of ashes, manures, and soils.

*Ashes and Manures.*—If the manures are mineral, it is sufficient to grind them before they are mixed with the silicate of iron. Organic manures ought to be at first reduced to ashes : if care be taken that the temperature does not pass beyond the low red heat, there is no danger of loss of phosphoric acid.

*Tobacco Ashes.*—The ashes are directly treated with silicate of iron :—

Ashes 0, grm. 982
Silicate 3, g. 5
Carbon 0, g. 4
} Phosphoric Acid found, 21, mg. 7 ; rate p. cent. 2·21.

II.—The phosphates are isolated by treating the ashes with nitric acid, filtering, evaporating, calcining at 300° Cent., and taking up the phosphates again by water ; the remainder contains the phosphate sought.

Ashes. . . . 1·067
Residue of the treatment . } 0·149·5
Melted with 1·200 Silicate and 0 300 carbon
} Phosphoric Acid found, 24·07; rate p. cent. 2·25.

There is, therefore, inconvenience in fuzing directly the ashes, without trying previously to extract the phosphates.

*Horse-Dung.*—800 grammes, dried in the air, gave 358 grammes ashes.

Phosphoric acid found, 2·38 per cent. in these ashes, or 1·06 in the dung.

*Soils.*—It is assumed generally that phosphoric acid is found in the various mineral elements, sands, clays, limestones, the mixture of which constitute soils. Now, it does not appear admissible to view it as equally present in these different minerals. That which is contained in non-calcareous sands may be considered as lost for vegetation, unless, indeed, these sands suffer a slow decomposition, as it is admitted some amongst them do ; but it may be admitted that the phosphates contained in clays, limestones, marls &c. are stored up as a reserve, and that natural chemical actions like that of silicate of potash upon the phosphate of alumina, as described by M. Paul Thenard, or those of carbonic acid and soluble organic elements upon the insoluble phosphatic salts, gradually decompose these, and place the phosphorus at the disposition of the agriculturist. It seems, therefore, suitable only to operate upon the mixtures containing phosphoric acid after the sand has been eliminated. M. Schloessing operates for analysis upon 10 grammes of the sifted earth ; he attacks it by nitric acid, and decants, as in the case of a mechanical analysis, in order to separate the clay from the dissolution. The decanted liquid is evaporated to dryness, the residue calcined at a low red heat, and melted afterwards with at least an equal weight of the silicate of iron. When the earth is very calcareous, the largest part of the lime may be separated by previous calcination at about 300° Cent., and by washing the residue with water in order to wash out and eliminate the nitrate of lime.

The following are a few results thus obtained :—

| | Sand. | Clay. | Lime-stone. | Organic | Humid. | Phos. Acid in 10 gr. |
|---|---|---|---|---|---|---|
| Earth from Boulogne (Seine). | 45·5 | 9·2 | 38·5 | „ | 7 | 24 mg. |
| „ „ M. Rolland (Moselle) | 77·2 | 11 | 0 | „ | 12 | 15 |
| Earth taken at Vaujours . . | 22·4 | 34·3 | 34·3 | „ | 10 | 19 |
| Earth from samples obtained from M. Hervé Mangon. Polder du Dain . | 40·3 | 36·4 | 19·4 | 16·0 | 4·8 | 16 |
| Bruyère . . | 69·2 | 5·6 | 4·3 | „ | 4 5 | 15 |
| Terre à Betteraves | 80 | 1·4 | 32 | „ | „ | 23 |
| Earth from a shallow marine pool. | 62 | 11·7 | 7·1 | „ | 2·4 | 10 |

There is found, therefore, 17 milligrammes of phosphoric acid for 10 grammes of earth, that is to say, from 6 to 8 tons per hectare.

M. Schloessing has, on account of the interest of the subject, expressed his intention to pursue at a future time further analyses in completion of these primary researches.

We, recognising the important relation that phosphorus bears both to agriculture and to metallurgy, and the real difficulties existing in its accurate determination at all times, have deemed this paper worthy of excerpt for the columns of this Journal.

## SODA MANUFACTURE ON THE TYNE.

By R. Calvert Clapham, Esq., F.C.S.

(*Continued from page* 37.)

The excise duty upon salt, at the date I am now speaking of, and for many years afterwards, was from 10*l.* to 36*l.* per ton, according to the exigencies of the wars in which England was then engaged; and so scarce and dear was salt to the working classes and the general public, that it was a common practice to bore holes in the wooden spouts, and convey the brine secretly to the workmen's houses to evaporate for domestic use. These high duties were not finally repealed till 1823.

Through the influence of the Earl of Dundonald with the Government, an order in Council was given that the salt made at Walker might be used in the manufacture of soda, free of duty, with a stipulation that soot or ground coal must be put into the pans, to prevent its use for other purposes; and an exciseman lived on the premises to watch proceedings. This peculiar privilege was found to be a great boon in establishing the soda trade at Walker.

The quantity of salt produced at first was not more than two or three tons weekly, but was afterwards increased to eight tons; and, as far as can be ascertained, this was the most that was made; which shows to what a limited extent chemical operations were then conducted. These salt pans continued at work till 1826. The first importations of Cheshire salt, at 12*s.* and 13*s.* per ton, commenced in 1825, and soon superseded the salt made at Walker.

Various manufactures appear to have been carried on at these works:—From 1800 to 1822 sulphur works were in operation, making about twenty tons yearly of roll and flour sulphur. Wood charcoal and pyroligneous acid were also made; and from the commencement of the works till 1806, the smelting of lead was conducted; at the same time the separation of the silver, and the production of litharge. In connection with the latter, the manufacture of soda commenced.

Other processes in making soda were also conducted, which will be described, but all of which have been long since abandoned; but they may be interesting to refer to, as forming part of the history of the introduction of the soda trade into the district.

(*a.*) Mr. Losh stated to the writer that one of the first processes adopted was the decomposition of salt with litharge, and in most of Lord Dundonald's papers, which are referred to also by the *Annales de Chimie*, and other French periodicals, he recommends 75 parts of oxide and 25 parts of salt; but it is doubtful whether these proportions were used at Walker. Large quantities of pig lead and lead ore were purchased to produce litharge; but the only large separate experiment I can find, in the late Mr. Thomas Bell's handwriting, gives 10 per cent. of salt, which produced 15 tons of British ashes, and left a profit of 20*l.* per ton.

The sub-chloride of lead resulting from this decomposition, when calcined, produced a deep yellow pigment; but from what can now be ascertained, its manufacture does not appear to have been prosecuted, the lead being simply reduced, and sold, as soft lead, to Walker, Ward, Parker, & Co., and others, at about 30*l.* per ton; and the silver to a Mrs. Robinson, at 6*s.* 6*d.* per ounce.

The soda obtained in solution from this process was evaporated to dryness, mixed with sawdust, and calcined, with the object of converting it into a carbonate, from which crystals of soda were made as far back as 1799, if not in 1798.

(*b.*) The chief operations, however, appear to have been in carrying out Lord Dundonald's patent, already referred to—the double decomposition of the salts of potassium and sodium. From 1802 till 1815, Russian potashes were purchased to a considerable extent, and then cost 40*l.* per ton. The mixture generally consisted of equal weights of salt and potash, which were first dried in a furnace, they were then mixed with slacked lime and coal, and balled. The solution from the ball was evaporated till the chloride of potassium could be separated by two crystallizations. The remaining solution was then dried down and furnaced, and was again dissolved to make crystals of soda. 40 cwt. of salt and potash produced 20 cwt. of muriate of potash, and 20 cwt. of British ashes; or, if crystallised, 30 or 40 cwt. of soda. The material called British ashes was sold as far back as 1804, and for many years afterwards, to Clapham, Foster, & Co., at the Ouseburn, from 16*l.* to 20*l.* per ton. The crystallizing was conducted at that time in small flat lead vessels, and only during the winter months; and the soda made by this process was sold as "potash soda."

(*c.*) A process which appears to have occupied a great deal of attention, and which continued from 1812 to 1822, was the employment of soaper's salts in making soda. The Tyne and Scotch soap makers generally made their soaps with kelp, which, as before explained, contained large quantities of sulphate of soda, chloride of potassium, and common salt. The leys from the soap works were evaporated to dryness, and sent to Walker, and this rough salt was worth 7*l.* per ton. It appears to have been always carefully analysed according to the old methods, and contained:—

| | |
|---|---|
| Chloride of potassium . . . . | 50 to 60 per cent. |
| Sulphate of soda and common salt . . . | 20 to 30 „ |
| Water and residue . . . . . | 10 to 20 „ |

It was mixed with its proportions of nitre cake (sulphate of potash) and dissolved in water, and evaporated to the crystallizing point. The chloride of potassium was separated, and the solution, consisting chiefly of sulphate of soda, was evaporated to dryness, and used as hereinafter described.

(*d.*) Nitre cake, obtained from the nitric acid makers of Glasgow, London, and Ireland, was also much used. It cost 14*l.* per ton, and consisted, at that time, of bi-sulphate of potash, and was treated as under:—10 cwt. of nitre cake was ground with 1 cwt. of salt, it was then furnaced, 5 cwt. of salt was added, and the whole was mixed with 7½ cwt. of coals, and 8 cwt. of slacked lime, and was balled. The ball was digested in water, and very pure chloride of potassium was separated, and the carbonate of soda was crystallized. In 1810, a parcel of 5 tons of Irish nitre cake, and 3 tons of salt, produced 42 cwt. muriates, and 64 cwt. British barilla, and left a profit of 10*l.* per ton on the latter.

(*e.*) In making glass at Messrs. Cookson's, and other works, with kelp, sulphates and chlorides of sodium and potassium floated on the top of the pot, and were skimmed off and sold under the name of "sandiver." It consisted of about:—

| | | |
|---|---|---|
| 50 | per cent. | of sulphate of soda, |
| 40 | „ „ | sulphate and muriate of potash, |
| 10 | „ „ | sand and glass, |

and was bought by Mr. Losh, for which he paid 8*l.* per ton; and it was used in the works at Walker, in the same way as the nitre cake.

These different operations were carried on according to the price of the materials at the time, and the chloride of potassium produced was sold to Mr. Mackintosh, of the Hurlet Works, near Glasgow, or to the Marquis of Normanby, at Whitby, at prices varying from 12*l.* to 20*l.* per ton. Both the Marquis and Mr. Mackintosh assisted in supplying a waste product from their works, called "alum slam;" a kind of bassic sulphate of alumina which was employed at Walker in decomposing salt.

The sulphate of soda produced from any of the above methods was decomposed by balling, and converted into carbonate. This operation was then conducted in the following manner:—The sulphate of soda, slacked lime, and coal, were each separately ground and finely sifted, and about half a hundredweight of sulphate of soda, with its proportion of coals and lime, was used to make a ball. The charge was mixed with water, or weak soda liquors, and made into the form of a paste, and was then placed upon what was called the shelf of the furnace, and, when ready, was pushed forward into the working bed. Six of these balls were worked in a shift of twelve hours; but, in time, ten were accomplished. The weight was increased to one hundredweight of sulphate in 1820, and these small weights continued to be the practice till 1838, after which time they were gradually increased to three hundredweight.

These were the methods adopted in making soda on the Tyne till 1821, and the new plan subsequently practised will be referred to hereafter. From the commencement of the works till 1820, a part of the produce was sold as British ashes, to the extent of about forty tons annually, testing from 15 to 20 per cent. of soda, and bringing 16*l.* per ton. When the new system of working commenced, ball soda was sold to a large extent till

1832, at 14*l.* per ton, when both products were superseded by alkali and crystals of soda. It is rather remarkable, also, that in spite of the great increase in the soda trade of late years, I find from Mr. R. Hunt, of Jermyn Street, that Spanish barilla was imported, in 1864, to the extent of 1,262 tons, and Scotch kelp was brought to the Tyne, in 1842, and refined.

As sulphuric acid occupies so important a place in the present system of making soda, I have taken great pains to obtain the best information concerning its introduction into England; and I believe it may be safely stated that the whole of what was made up to 1730 was produced from sulphate of iron. Copperas works had existed in England from an early date; in 1748 they began at Hartley, and in 1797 at Walker. The copperas, after being dried, was placed in brick ovens, to which a strong heat was applied, the acid distilled off, and was condensed, and formed an impure oil of vitriol. If one ton of copperas produced 1½ cwt. of acid, it was considered a fair result. The price was 2*s.* per lb., or 220*l.* per ton; the present price being only 6*l.* per ton.

The next step in advance was the attempt to make oil of vitriol from sulphur. This was done in 1736. The plan was as follows: The sulphur and nitrate of potash were suspended on an iron tray, in large wide-mouthed glass globes, partly filled with water, and was set fire to by a red-hot iron, and the mouth was then closed. As soon as the charge was completed, another took place, till the acid was found to be sufficiently strong, when it was removed into a glass retort, and concentrated much in the same manner as at present. This acid also brought 2*s.* per lb., and was in much demand, on account of its purity, for several years.

In 1746 a Dr. Roebuck, of Birmingham, stated to be a man of considerable scientific attainments, put up the first leaden chambers in England, as a substitute for glass globes. These were six-feet square, and the charges of sulphur and nitre were burnt in the chambers, in the same manner as in the glass globes. The success of these chambers was so great, that others were erected at Preston Pans, in Scotland, in 1749; and shortly afterwards at Bridgenorth and at Bewdley, and in London, in 1772, and in Lancashire, in 1783. The manufacture of oil of vitriol, by the new method, gradually superseded the old one from copperas; and the total quantity from both sources had so far increased that, in 1790, England became for the first time an exporter, to the extent of 2,000 tons, instead of a large importer of oil of vitriol.

The first sulphuric acid chambers were put up on the Tyne, at Bill Quay, about 1812 to 1815, by Doubleday and Easterby. The acid produced was sold at first at 3*d.* per lb., and afterwards at 2*d.* per lb.; a part of it was also used to decompose soapers' salts, which were taken down the river to Bill Quay from this firm's soap works, in the Close, to avoid any annoyance to the Corporation authorities, in the Mansion House there. The sulphate of soda produced was converted into British barilla, and used in the soap works.

At the time the Bill Quay works began to make acid, the plan still adopted was to burn the sulphur and nitrate of potash together. But improvements had so far advanced, that this operation was conducted in a separate furnace, and the gases evolved were conveyed by a pipe into the chamber. No steam was then used.

When the charge was burnt off, three hours were allowed for the condensation of the gases, and the doors of the chambers were opened to what was called sweeten the chamber, and then the operations were continued as before. The acid was then generally brought up to 70° or 80°, when it was run out, and a fresh supply of water took its place. The produce of acid by this plan was not more than 36 or 40 cwt. from a ton of sulphur, or 180 to 200 per cent.

In 1821, Mr. Losh erected acid chambers at Walker, for the purpose of decomposing salt, and manufacturing soda on the French plan; and Mr. Charles Tennant commenced similar operations in Glasgow, in 1819, so that these appear to be the first two alkali works commenced in this country on the French plan. The chambers erected at Walker were about 25 feet long by 10 feet wide, and 10 feet high; and two were put up at first in the lower part of the works, by a plumber from Glasgow. In the following year two larger chambers were erected, and the four chambers were all that were put up for some years. The price of sulphur at that time was 7*l.* per ton (the duty being 15*l.* per ton, which was remitted), and nitrate of potash was 32*l.* per ton.

Improvements had so far advanced, that the nitrate of potash was decomposed by sulphuric acid in a separate pot, steam was introduced into the chambers, and, at the same time, continuous working of the process, which very largely increased the produce of acid.

During the change of manufacture, large quantities of oil of vitriol were purchased, which cost 18*l.* 10*s.* per ton. Owing partly to the high price of nitre, and the large quantity then used, the cost of making sulphuric acid could not be less, for the first few years, than 6*l.* or 7*l.* per ton.

The sulphur used was all derived from Sicily. The duty of 15*l.* per ton was reduced in 1825 to 10*s.* per ton. The price delivered in the Tyne, after the reduction of the duty, was about 6*l.* to 8*l.* per ton. This state of things continued till 1838, when the King of Sicily entered into an agreement with Messrs. Taix & Co., of Marseilles, for the exclusive sale of all the sulphur produced in his dominions. The effect of this was an immediate advance to 13*l.* or 14*l.* per ton, and a great depression and stagnation in the alkali trade. Under these circumstances, the attention of chemists was directed to pyrites, as a substitute for sulphur, which was found in abundance in Cornwall and Ireland. This mineral was first imported into the Tyne, in 1840; and, in June of that year, was used by Mr. John Allen, at Felling Shore, and in September, by Messrs. H. L. Pattinson & Co., at Felling.

Foreign pyrites, of higher strength than the English or Irish, were imported in time:—*In 1856, Spanish pyrites were first used; in 1858, Belgian pyrites; in 1861, Westphalian pyrites; and the same year Norwegian.

Perhaps nothing can give a more correct impression of the progress of chemical manufactures than the production of sulphuric acid. The Custom-House gives very imperfect returns of imports earlier than 1840; but from private sources it may be safe to say, that, in 1820, not more than 200 or 300 tons of sulphuric acid were produced on the Tyne. Parks of London, himself an acid maker, and a close observer, states that in 1815 not more than 5,000 tons of acid were made in the whole of England.

In 1830, the produce of acid on the Tyne may be calculated at about 3,300 tons, and advancing to 1867; and acting on more certain returns, it appears that the production of sulphuric acid has increased to 140,000 tons, which is certainly an enormous increase.

The production of crystals of soda being confined to the Walker works till 1827, when Mr. Cookson came into the market, I am able to give the quantities made on the Tyne in the following years. The crystallising was chiefly confined to the winter months, viz. from October to May:—

| | | |
|---|---|---|
| 1799— | 10 | tons crystals of soda were made. |
| 1800— | 23 | „ „ |
| 1805— | 57 | „ „ |
| 1810— | 66 | „ „ |
| 1815—130 | | „ „ |
| 1820—121 | | „ „ |
| 1825—406 | | „ „ |

In 1830, the production at the Walker works had increased to 986 tons, and, in addition to this, three other makers had produced about 2,300 tons, making the total production, in 1830, about 3,300 tons. The returns for some years after cannot with accuracy be made out; but in 1867, as before stated, the produce of soda crystals on the Tyne was 86,000 tons, besides a very large quantity of alkali, showing an enormous increase in seventy years.

It may also be interesting to refer to the prices of soda for the last seventy years;† and, in comparing the prices, the small quantities produced, and the general circumstances of the times, should be taken into consideration:—

| | | | | |
|---|---|---|---|---|
| In 1799— | £50 | 0 | 0 | per ton. |
| „ 1800— | 44 | 10 | 0 | „ |
| „ 1805— | 47 | 1 | 0 | „ |

* The writer is indebted for this information to Mr. A. S. Stevenson, Mr. H. Scholefield and Mr. H. Clapham, who are all extensive importers of foreign pyrites.

† The writer is indebted to Mr. Thomas Bell for much of this information.

| | | | | |
|---|---|---|---|---|
| In 1809— | £62 | 17 | 0 | per ton (*highest price to £71*) |
| „ 1810— | 59 | 1 | 0 | „ |
| „ 1815— | 54 | 10 | 0 | „ |
| „ 1818— | 40 | 5 | 0 | „ |
| „ 1820— | 36 | 10 | 0 | „ |
| „ 1825— | 29 | 0 | 0 | „ |
| „ 1830— | 18 | 5 | 0 | „ |
| „ 1835— | 11 | 0 | 0 | „ |
| „ 1840— | 10 | 2 | 6 | „ |
| „ 1845— | 6 | 10 | 0 | „ |
| „ 1850— | 5 | 10 | 0 | „ |
| „ 1855— | 5 | 2 | 6 | „ |
| „ 1860— | 6 | 15 | 0 | „ |
| „ 1865— | 4 | 15 | 0 | „ |
| „ 1868— | 4 | 2 | 6 | „ |

From 1779 to 1825, the casks were charged extra, and averaged from 25*s.* to 30*s.* per ton.

## LOCOMOTIVE FIRE BOX STAYS.

Some boiler makers profess to have trained their ears so nicely in observing the sound which is produced upon striking the heads of fractured locomotive boiler stays, that by the magic touch of the hammer they can detect a broken stay. Whilst, doubtless, a well practised ear may in this way be useful, and indeed is in practice largely relied upon (much too largely, indeed), still it is one of those rough and ready, and therefore uncertain, workshop tests which should be as rapidly as possible wiped out of use.

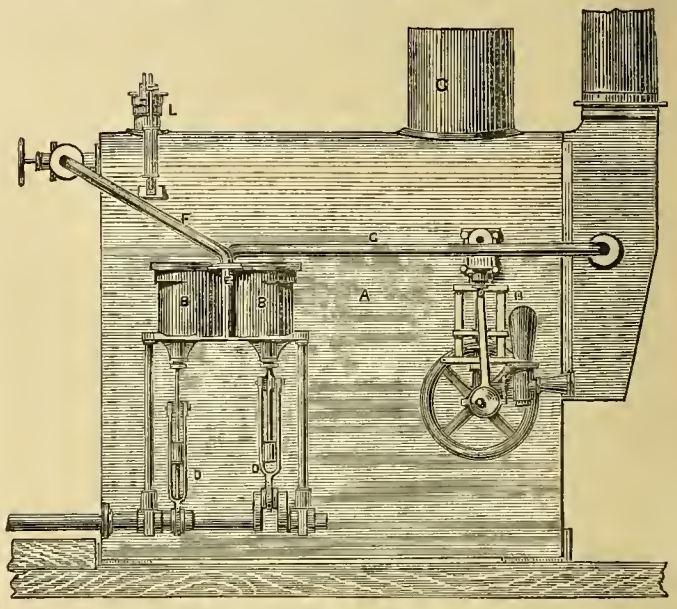
A very little consideration will at once show how, on such a test, the result arrived at is circumscribed with large probabilities of error in judgment. For let us take a very common example—thus a fire-box side, with the stays spread at distances of four or five inches from centre to centre. Suppose that all these stays are whole, the sound produced by the hammer blow on each will be different according to the distance of each stay from the side or boundary line of the fire-box—and will differ also according as the stay struck may be surrounded with many or few broken stays—in fact, if the stay struck be surrounded with broken stays, the difference of sound produced with the hammer test applied to it and its neighbours will scarcely vary, especially as it is well known that in the case of broken stays the fractured parts come close together and bear firmly on each other when the boiler is cold, and in which state only it is usual to apply the hammer test; so closely indeed do the fractured parts bear on each other, that after a hole is bored down through the axis of a broken stay, and the boiler charged with hydraulic pressure, it has, with the highest pressure which it would be safe to employ without injury to the boiler, been found impossible to force the water through the fracture and out into the central hole. When, however, the pressure has been applied to a hot boiler, the steam and water have both shown themselves in the fractured stay.

It is a well-known fact that almost always, if not always, fire-box stays break close to the outer shell, and in order to be sure of detecting a fracture immediately that it occurs, Mr. Cowan, locomotive superintendent of the Great North of Scotland Railway, has a small hole drilled through the centre of the outer end of each stay, to a distance inwards which extends slightly beyond the thickness of the outer shell, as shown in the woodcut adjoining. In this manner every fractured stay at once declares itself, because as soon as fracture takes place steam and water escape from the central hole *a*. We strongly urge the attention of boiler makers, locomotive, marine, and portable engine engineers, to the adoption of this very simple and efficacious expedient, which is now employed with all the stays put in, at the Kitty-Brewster Works. Its application must be productive of economy in every case, for it can scarcely be doubted that hitherto by trusting merely to the boiler maker's ear, and the treacherous touch of his hammer, many stays have been cut out through having been pronounced broken, whilst in reality they were sound. V.D.

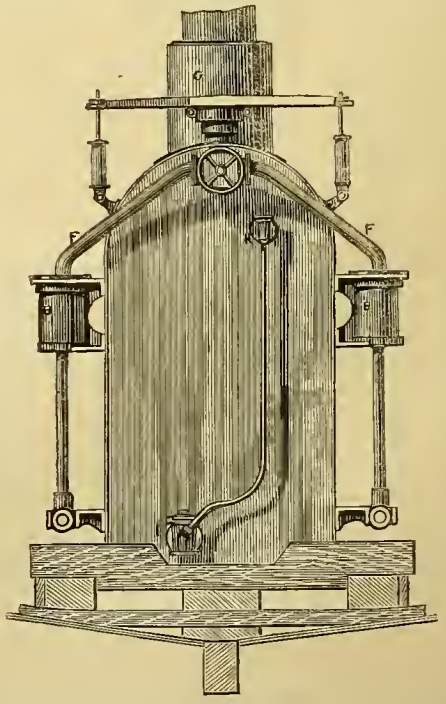
## ENGINES OF STEAM LAUNCHES.

The engines represented in the annexed engravings are of the type of steam-launch engines made by Messrs. T. and G. Rennie for H.M. ships, as well as for many foreign governments.

The arrangement consists of a boiler A with a pair of cylinders B bolted on either side for driving two screw propellers, one under each quarter of the boat. The boiler has flat sides and ends, the top being semicircular, with a steam chest C placed on it.




There is one furnace, 2 feet broad and 2 feet 6 inches long, with a smoke-box at the back. Over the furnace there are 40 brass tubes, 3 feet 6 inches long. The boiler is strongly stayed, and proved with a pressure of 180 lbs. previously to leaving the works of Messrs. Rennie. This boiler for the amount of surface is one of the most compact forms adopted, the length being only 5 feet, breadth 2 feet 5 inches, height 4 feet 6 inches. The cylinders are




four in number: diameter of bore 5 inches, stroke 6 inches. They are of the simple, single piston-rod type, with forked connecting-rods D. The slides E are between the two cylinders, and one steam-pipe F is led direct into the slide jacket of each pair of

cylinders. Each pair of cylinders has also a separate exhaust-pipe G, uniting in the lower part of the funnel. A small donkey-engine H (which can also be used as a hand-pump) is also provided for feeding the boilers, as also a blow-off cock I, and a scum or surplus steam discharge K, and two safety valves L. There are two lines of shafting with gun-metal four-bladed screws, 2 feet 6 inches in diameter, and a pitch of 3 feet. The boats or launches are usually about 42 feet long and 11 feet beam, and with a mean draught of 2 feet 6 inches when loaded to a displacement of ten tons. This class is propelled by the above-described machinery at a mean rate of 8·251 knots, taken over six runs; the mean revolutions 318·16 per minute; boiler pressure 75 lbs.; mean indicated horse-power 37·54. These engines are so arranged that they may be readily lifted out and fixed in the boat, leaving only the shafting and screws &c. in the boat; the weight of engines and boilers complete being only 1 ton 19 cwt. to be lifted out, and 13 cwt. remaining in, making a total weight of 2 tons 12 cwt. In consequence of the rapid deposit of saline matter in the boilers by the use of sea water, it has been found necessary to fit the boilers with tanks for fresh water, except in the cases where Messrs. Rennie have fitted them with surface condensers.

## MECHANIC'S LIBRARY.

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## RECENT PATENTS.

### MOUNTING AND WORKING ORDNANCE.

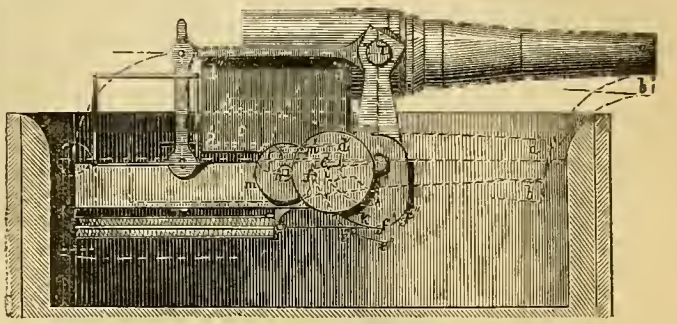
JOHN HENRY JOHNSON, 47 *Lincoln's Inn Fields; a Communication from* JULES CÉSAR HOUEL *and* FERDINAND LOUIS FELIX CAILLET, *Paris.—Patent dated February* 5, 1869.

THIS invention relates partly to an improved mode of mounting ordnance suitable for either land or naval service, the object being —1. To keep the gun concealed from the enemy except during the moment it is being fired; 2. To store up either the whole or a portion of the force exerted by the recoil of the gun, and to utilise the same in bringing the gun to its firing position; 3. To effect the elevation and firing of the gun automatically.

The accompanying engraving represents one modification of a gun-carriage constructed according to this invention. *a* shows the gun in its position for firing, with its axis in a horizontal direction; *a'* shows its position when housed, the axis being also horizontal; *b* shows the gun placed at an angle of 5° in its position for firing, and *b'* the position of the gun at the same angle when housed; *c c'* are the sighting slide and wedge; *d d' d'' d'''* is the frame carrying the pointing mechanism; *e e' e''* shows the sinusoidal curve; *f f' f''* shows the regular curve; *k* is the concussion tampion to act as a stop or check to the gun in firing; *m m'* is the brake; *n* is the pinion to which a winch handle is applied in order to work the gun by hand; and T are the trunnions.

This system of gun-carriage is composed of a strong metal frame, to which are jointed the sides of the double parallelogram, which supports the piece of ordnance, and the top sides of which carry a species of frame which serves as a point of support to the breech, or to the cushions or pointing screws interposed. The two fore ascending rocking arms or sides of the parallelogram are made of suitable strength to support the gun, the weight of which they bear alone, and to withstand the force of the recoil; the other sides, being simply guide-rods, are made much lighter, and their distance apart is maintained by horizontal tie-rods or cross-pieces.

With a view to collect or accumulate the whole or a portion of the power produced by the lowering of the gun and its supports, and by the reaction due to the recoil, the rocking arms are prolonged below the points where they are jointed, and are connected at their lower extremities either to springs fixed to the carriage, or



to a moveable counterweight. In the first case their lower surface is cut away in the form of the arc of a circle, or of a sinusoidal curve properly calculated, and receives the chains which contract the springs, the latter being so arranged that they may be more or less tightened at will. As in many cases it may be desirable to store up only a portion of the mechanical force developed, brakes are provided on the axes of the rocking arms, by means of which that portion of the force which may be considered prejudicial to the facility of working the gun may by friction be absorbed.

As the gun remains constantly parallel to its own axis, it may be adjusted as regards the aim while it is shielded behind the parapet, and be discharged as soon as its mouth has passed the level of the battery; the gun is immediately lowered by the effect of the explosion, and, after having been reloaded, it is simply necessary to release the moveable catch which retains it, in order to cause it to rise, and in its upward motion stretch the chain which brings into play the apparatus destined to effect the ignition of the priming.

### STEAM-ENGINE GOVERNORS.

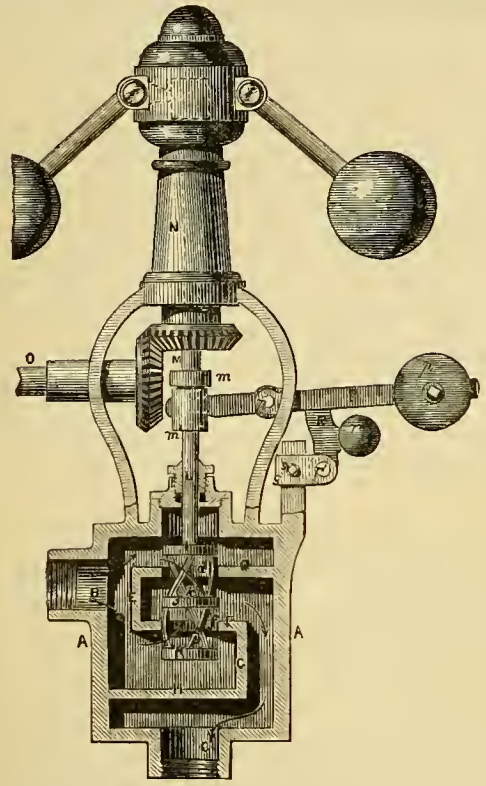
JOHN HENRY JOHNSON, 47 *Lincoln's Inn Fields; a Communication from* WILLIAM BELLIS, *Richmond, Indiana, U.S.A.—Patent dated February* 8, 1869.

THIS invention relates, firstly, to a peculiar form of governor-valve which, in addition to the advantages of great compactness and mobility, possesses the facility of closing automatically in the event of the snapping or running off of the governor-belt, or the sudden suspension of the governor action from any other cause or accident. Secondly, to a device for holding such governor-valve open when the steam inlet-valve or throttle is shut, so as to enable the engine to be started by the opening of the said throttle.

The annexed engraving is a front elevation partly in section of a valve and its accessories embodying this invention, the governor being at rest, the valve open, and the steam just entering from the opened throttle. The valve-chamber A may have the represented rectangular or other external form, and has the customary inlet-neck B, and outlet-neck C, which necks are separated by an S-formed diaphragm D E F G H, of which the portions D, F, and H form horizontal shelves, connected by the vertical walls E and G. Of these parts the shelves D and F are traversed by circular ports *d* and *f* of equal size.

The governor-valve proper consists of three precisely equal parallel and equidistant discs I J K, of which the upper and lower discs I and K are separated from the middle disc J the precise distance which separates the shelves D and F. The several discs are connected by wings, ribs, or bars *i j k*, which it is preferred to make flush with the peripheries of the discs, and of a spiral form, in order that, in the vertical oscillation of the valve, it may be guided easily and truly with the openings of the seats, and that every part of the seats may be equally sub-

jected to wear. L is the valve-stem, which is connected to the governor-stem M by a swivel *m*. N is an ordinary governor, of which O is the driving-shaft. The stem-coupling *m'* is slotted, as shown, to receive the lever P, which is fitted with an adjustable weight or counterpoise *p*, and works on a centre at *p'*. This weighted lever may be used to give a variety of speeds to the engine, or to adjust its velocity to a certain number of revolutions, but it is also used to sustain the valve I J K in the open position when the engine and governor are at rest. This is accomplished by the aid of a prop, gravitating-catch, or tumbler R, which is weighted at *r* and pivoted at *r'* to a sliding-block S, which is adjustable by a set-screw *s*. When the engine is to be started, the valve I J K is held open by the weighted stop or prop R being turned up under the lever P. The stop R is held in position by the weight of the governor-balls and weighted lever P. The steam being applied, the governor begins to operate, and as soon as it attains sufficient velocity, the balls rise and release the stop R, the weight on which immediately causes it to drop out of the way, and leaves the governor and valve to operate in the usual manner.




It will be observed, by reference to the construction and arrangement of the valves I J K and apertures *d f*, that the ports are closed both by the extreme extension and by the extreme contraction of the governor-balls, so that the ports *d f* may be closed or partially so, as may be required, to check the engine in the regular legitimate action of the governor while in motion ; or the ports may be suddenly and completely closed and the engine stopped by the breaking or running off of the governor-belt. With this arrangement it is always necessary either to prop the lever P in the manner described, or to elevate the same by hand before starting the engine. When the governor-valve is closed by the extreme extension of the balls, the discs I J close or fill the ports *d f*, and prevent the passage of steam, and when it is closed by the extreme contraction of the balls, the discs J K occupy the ports *d f*, and equally prevent the passage of them.

In addition to the feature of closing in either direction, the provision of double ports and the peculiar construction of the triple valve I J K with an open centre admits of the employment of a valve of small diameter. Thus, an ordinary governor-valve of two inches in diameter has an area of 3.1416 square inches. This area can be obtained by the use of an inch and a half valve of the improved construction, the area of the two discs being 3.534, from which deduct .375 for the bars or wings *i j k*, and an area of 3.159 is left for the passage of steam.

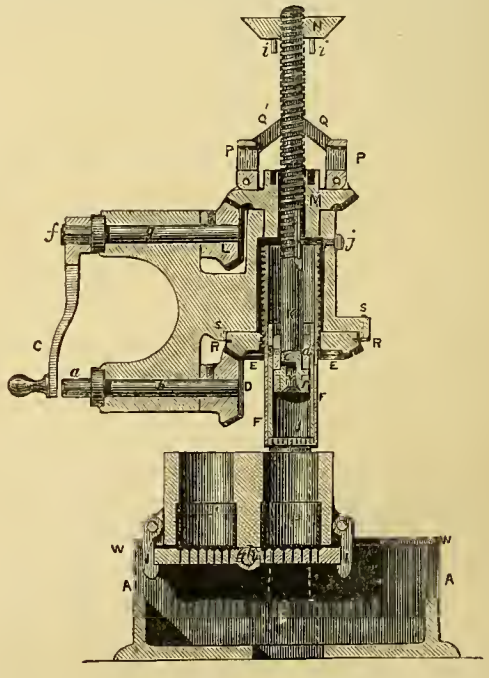
A small valve has less friction, and as it requires less power to operate it than a larger one, the governor is more sensitive and mobile. This valve further possesses the advantages of being completely steam-balanced, whether open or shut, and under every pressure of steam.

## MANUFACTURE OF BOXES FROM PAPER-PULP.

John Henry Johnson, 47 *Lincoln's Inn Fields; a Communication from* Richard Smith, *Shelbrooke, Canada.—Patent dated January* 11, 1869.

This invention consists essentially in making paper-boxes, and other hollow articles, direct from pulp in moulds, by the action of combined plungers, which come into action successively, so as to first raise the pulp up the sides of an inner plunger, and then to compress such pulp by the descent of an outer cylindrical plunger, the completed pad being expelled through the bottom of the mould. Two moulds are used, traversing to and fro under the plungers, so that one may be filling whilst the other is at work, and *vice versâ*. The invention will be clearly understood on reference to the annexed engraving, which is a sectional elevation of the apparatus employed.

A is the bed-plate and frame of the machine ; B B uprights, which support the upper portion of the frame to which the gears are attached ; C a winch, representing the driving-power, of whatever nature it may be, applied to the shafts of the driving-gear ; D is a




bevel-gear, having a shaft *b* with a square head *a* for the reception of the winch C. The wheel D gears with the bevel-gear E, which is threaded on its interior surface, and acts as a nut to raise and lower the cylinder F, which passes into it, and is threaded on the upper portion of its outer surface, to correspond with and receive the thread on the inner surface of the gear E. The downward movement of the cylinder F imparts end-pressure to the upper edge of the box. The gear E has a groove or dowel in its periphery, which receives the inner edge of an annular plate R attached to the frame by screws *s s*. This plate supports the gear E in its place, while allowing of its free rotation. H H' are the moulds, united together, and attached to a common bed-plate, which slides in ways W, having a reciprocating movement below the cylinder F. The inner sides of the moulds have vertical grooves in

them, covered with a fixed lining of wire gauze. The bottoms of the moulds are formed in the same way, their grooves connecting with the lower ends of the side grooves, which thus drain into them. These bottoms are hinged at *h* to lugs on the bed-plate of the moulds, and open downwards, being held up by catches I I′ hinged to the ends of the same plate, while the box is being made. J is the plunger, which operates inside the cylinder F. It is a hollow cylinder, open at the top, and closed at the bottom by a perforated plate, having concentric grooves below, and covered on the outside by wire gauze. It fits the inside of the cylinder F, and is the "former" for the inside of the box to be produced. In the plunger is inserted a piston, packed with an annular piece of rubber *r*, which fits it loosely, so as to allow air to pass around it. The piston is attached to the lower end of the piston-rod K. Through it is an air-passage *c*, in which is a valve *v* operating, both by its weight and by atmospheric pressure, to open the passage *c*, and admit air under the piston. This valve is closed when the bottom of the piston is in contact with the bottom of the plunger, the valve being then forced against its seat. A collar *d* is attached by a screw *e* on the inside of the upper end of the plunger J. Its office is to prevent the piston from being drawn out of the plunger when the piston-rod K is drawn up, and to insure the rise of the plunger with the rod K, after the latter has risen far enough to bring the top of the piston into contact with the lower edge of the collar. The rod K is plain on its lower portion, as shown, but threaded above. It has a vertical groove on its side, into which the end of a screw-pin *j* enters, to keep the rod from turning when acted upon by the nut. The thread on the rod K engages with a similar thread in the nut N, but passes freely through the bore of the gear M. The gear M engages with the gear L, whose shaft *g* has a square head *f*, which receives the winch C, by which it is driven. Hinged to the upper surface of the gear M are two spring-catches P P′, which are drawn together by a spiral spring, but can be pressed apart, and, when separated, held open by the toggle-arms Q Q′. They are pressed open by the inclined faces of the nut N, which nut they receive and hold firmly to the gear M, the pins *i i′* on the bottom of the nut entering holes in the upper end of the said gear, thus compelling the nut and gear to turn together.

The operation of the machine will be obvious from the foregoing description.

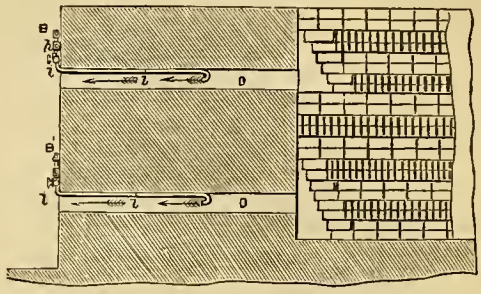
## BURNING BRICKS.

JOHN HENRY JOHNSON, 47 *Lincoln's Inn Fields; a Communication from* HENRY WRIGHT ADAMS, *Philadelphia, U.S.A.*

THE essential feature of this invention consists in so constructing a brick-kiln as that the products of combustion from fires contained in furnaces at one end of the kiln are caused to forcibly permeate the mass of bricks by the action of jets of steam or other equivalent exhausting source situate at the opposite end of the kiln, and *vice versa*, the products of combustion being caused to pass through the mass from one end to the other of the kiln, first in one direction and then in the opposite direction, thereby heating the bricks uniformly throughout. Jets of steam are also directed into the combustion-chambers and over the fuel of those fire-places which are in action for the time, as well as into their corresponding ash-pits.

The invention will be clearly understood on reference to the accompanying engravings, in which fig. 1 is a longitudinal vertical section of the kiln, showing the opposite ends of the same; fig. 2, a longitudinal vertical section through the centre of the kiln; and fig. 3, a transverse vertical section through the fire-places. The kiln is of oblong form, the permanent portion consisting of the opposite ends A and A′, connected together by side walls, and the whole enclosing an oblong space for containing the bricks to be burned.

Fig. 2.



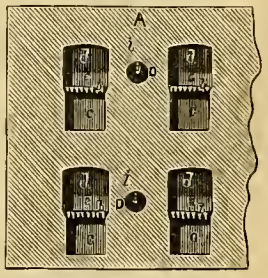
In each end of the kiln are built two tiers of fire-places, six in each tier, and each fire-place consists of a combustion-chamber *a* and ash-pit *c*, separated by the ordinary grate-bars *b*; the combustion-chamber being furnished in front with a suitable door or doors, and communicating at the rear with the interior of the kiln, through a passage *d* over a bridge *e*.

At each end of the kiln are arranged pipes B and B′, one above each tier of fire-places, and communicating with the steam space of an adjacent boiler, and from one or other of these pipes projects a branch-pipe *f* into each fire-place; this branch terminates at a short distance from the entrance of the combustion-chamber, and below the roof of the same, so that a forcible jet of steam may be directed in the course taken by the products of combustion.

A branch-pipe *h* also extends from one or other of the main steam-pipes B or B′ into the ash-pit, so that a jet of steam may be projected into the latter below the grate-bars.

In each of the permanent ends A and A′ of the kiln are openings D, there being in the present instance three openings above and three below, and situated between the fire-places.

Fig. 3.

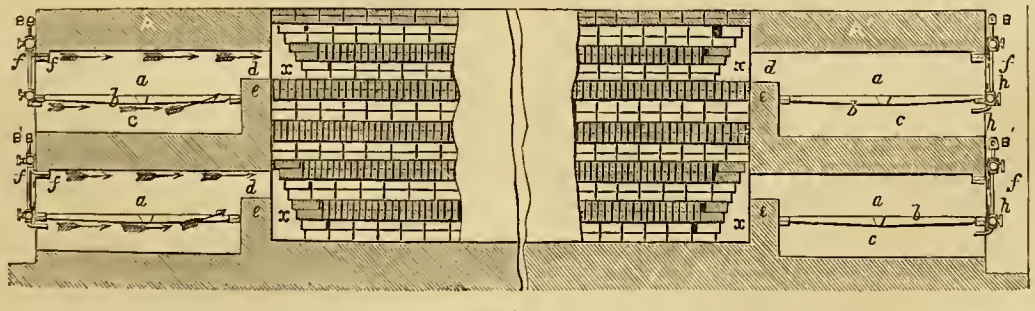


Into each of these openings projects a pipe *i*, turned at the end, so that a jet of steam may be projected outwards, and induce a partial vacuum within the kiln.

The different branch-pipes are provided with suitable cocks or valves by which the passage of steam may be regulated or stopped at pleasure.

In using this kiln, the moulded bricks, just dry enough to bear handling, are arranged as shown in the engravings, care being taken to leave at the rear of each row of fire-places the chambers *x* extending across the kiln. The upper chamber, however, should be entirely separate from the lower. We think the operation of this kiln will be obvious from the foregoing description.

Fig. 1.

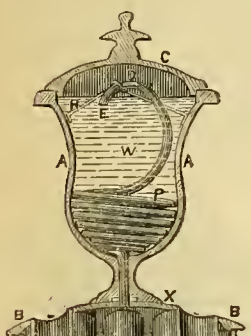


## HEATING AND VENTILATING.

JOHN HENRY JOHNSON, 47 *Lincoln's Inn Fields; a Communication from* JOHN JOHNSON, *Saco, Maine, U.S.A.—Patent dated February* 9, 1869.

THIS invention has reference to apparatus for heating and ventilating, for which a patent was granted to the present patentee, dated the 16th April 1868 (No. 1250), and consists—firstly, in improvements in the radiators for warming and ventilating apartments, and also in cooking utensils, stoves, and ovens; and, secondly, in a self-acting feed apparatus for effecting the supply of fresh water in limited quantity to the steam-generator.

The improved radiator and ventilator consists of an upper and lower chamber or box connected together by a series of pipes placed either in pairs, one being under the other, with an annular space between the inner and outer pipe; or a series of concentric pipes may be employed; the several annular spaces in the one case, or the alternate annular spaces in the other case, communicating with the interiors of the two chambers, whilst the central pipe, or the other annular spaces, open completely through such chambers, but do not communicate with their interiors. Steam is admitted from a generator to the lower chamber, and passes up the annular spaces communicating with the upper chamber, whilst the air to be warmed by the heat radiated from the two surfaces of the external and internal pipes, passes up the internal pipe or pipes, and along the outside of the external pipes; the increased radiating surface presented by the radiator tending to heat the air quickly, and produce a constant and rapid upward current therein, thereby warming and ventilating the apartment. Stop-cocks are provided on the upper and lower chambers, for the escape and entrance of the steam and for blowing out the air on commencing to use the radiator.




The improved heating apparatus for cooking purposes consists of a species of oven, or heating chamber, composed of an inner and outer shell, the inner one forming a chamber for the reception of the food to be cooked or heated, which chamber is furnished with a tight-fitting lid or cover, so made as to radiate as little heat as possible. The outer shell, or steam generator, contains a small quantity of water, or other vaporisable liquid, which is vaporised by a lamp or gas light, or by a small fire beneath. A plugged orifice is provided for the introduction of the water or vaporisable liquid and the self-feeding apparatus.

The self-acting feeder, which constitutes the *second* part of this invention, and which is shown in the annexed engraving, consists of a water reservoir A, by preference in the form of an urn provided with a cover C, which is in communication, by means of a coiled pipe P, with the interior of the steam generators hereinbefore referred to, containing the small quantity of water to be vaporised. The coiled portion of the pipe (P) occupies the lower portion of the urn; its lower end passes through the bottom of the urn into the generator (B), whilst its upper end is bent so as to form a syphon. The lower part of the urn is fitted steam-tight to the top of the heater, as shown at X. When the urn is charged with water (W), the mouth of the pipe just dips beneath the surface, as shown at E, whilst the bend D, which is supported by the tie-rod R, is a little above the water level. Having supplied a small quantity of water—say, about two cubic inches, to each cubic foot of space in the generator, and applied heat thereto, the air in the generator is rarefied, and passes out through the mouth of the coiled tube, and continues so to do until the generator is filled with steam of the atmospheric tension. Should the steam not be condensed as rapidly as it is generated, the mass of steam in passing into the coil loses its latent heat, and becomes condensed; the water produced thereby falling to the bottom or boiling part of the generator. As the water in the urn becomes gradually warmer, a small per-centage of the water in the heater will occupy the urn, closing up the mouth of the syphon. But so soon as the pressure or temperature in the generator is reduced, a supply of water will quickly re-enter the generator, and air will follow, thereby keeping up the original quantity of water that was placed within it. As it is desirable that a small quantity of water be used for condensation, an open pipe may be fitted into the top of the generator for the escape of steam, and just below this an open cup is provided. A bent pipe is inserted into this cup, which pipe enters the generator, and, being always filled with water, forms a seal to prevent escape of steam into the cup. The lower end of the condenser pipe in the urn is trumpet-shaped, and the steam passes up it as it escapes through the open pipe. As the steam issues into the air it loses heat; the condensed water falls into the cup, and thence through the water-sealed pipe into the generator, to be again converted into steam. By these devices the steam, air, and water are regulated automatically; and the generators may be made of any thin metal not liable to collapse or explode, and light enough to be moved readily from place to place. This self-acting feeder is equally applicable to the generators described in the specification of the former patent hereinbefore referred to.

## REVIEWS OF NEW BOOKS.

### FOREIGN LITERATURE.

*Mittheilung des Gewerbe-Vereins für Hannover.* 1869. Heft. 1 & 2. 4to.

THIS German periodical, which, as we before remarked, will never be popular reading either in England or France while printed in eye-straining close Gothic characters, maintains also its usual style. There are a few original papers, but the larger portion consists of articles or intelligence taken from other sources.

*Bibliothèque des Professions industrielles et agricoles. Séries B et C.* Small 8vo. Lacroix, Paris.

THERE must surely be something in the logical and order-endowing heads of our French neighbours, that makes them not only so much better popularisers of science, and of everything abstract or exact, than ourselves, but even the best vulgarizateurs in the world. Against the admirable and extensive series of volumes of this "Library" of Mons. Lacroix, due, indeed, to his capital, energy, and discretion as publisher, but also to the intellectual labours of a large band of authors as contributors, what have we in England to produce? Nothing, we fear, more worthy than "Weale's Series;" a set of multitudinous volumes on most heterogeneous subjects, of which many ought to have been long ago let to die a natural death, due to their age and congenital infirmity, but in which also there are, no doubt, a few volumes of first-class excellence, some of which, too, have had their value enhanced by good re-editing. But taken as a whole, the "Series" cannot bear comparison for an instant with those of Lacroix; as to which, it might not be a bad publishing speculation to translate them bodily into English for this country and for American consumption.

Amongst the latest volumes that have reached us of Lacroix' "Bibliothèque" are the two on the *Théorie mécanique de la Chaleur* of *R. Clausius*, translated by M. Folie. The original work, known for its importance and originality amongst all who are interested in the progress of this striking and still almost new branch of physics, our readers are aware, dealt with one particular law of thermodynamics mainly, and is scarcely a complete treatise on the subject, embracing that in all its parts; and it is extremely abstruse and abstract throughout, commencing, as it does, by a mathematical introduction "On the method of treating differential equations which are not integrable in the ordinary sense," which gives note of what is to follow.

This volume, therefore, though excellently-good service has been done by making it accessible in French, at a low price, and so clearly printed, and with the beautifully-given notation of the French school, cannot be expected for a long time to become really popular.

The mechanical world needs much more education first, at least

in English-speaking lands. What really is needed at present to push forward the knowledge, as a branch of mechanics, of thermodynamics, is a good and brief book, complete as to its purview of the subject, and given, not in mere popular language, however clear and impressive—as in Prof. Tyndall's "Heat a Mode of Motion"—but by the free use of symbols, but avoiding as far as possible all higher or transcendental mathematics, and throughout explaining each step in advance made algebraically, in common language.

Professor Tate's work does not fulfil this, nor do Rankine's either; both are habitual and exercised mathematicians, and feel no bowels of compassion for those whose time and attention, exhausted by other and lower, it may be, calls or callings, cannot and will not wade (even when they are competent to do so, which is seldom,) through pages of differentials, ending in merely demonstrating something which these readers would be quite willing to accept on faith from the pen of the mathematical prophet.

Amongst the other volumes before us are

*Armes et Poudres de Chasse*, par Louis Roux, Ingénieur des Poudres. —A good popular résumé of our knowledge of gunpowders, and of their applications in small arms for sporting and for war.

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*Carnet de l'Ingénieur.*

The fourteenth edition, for 1869, is better than its predecessors because of later and revised edition, and a good and not too cumbrous pocket-book for engineers, but perhaps rather too miscellaneous, and in point of strictly mechanical and civil engineering a good deal below the level of some of the German pocket-books, notably those of *Weissbach* and of the *Hüttevereine.*

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*Essai sur l'Administration des Entreprises industrielles et commerciales.* Par Lincol.

This is a treatise, so to say, upon the political economy and methods of judging of the inception, and of successfully working industrial and other projects, or, as we irreverently term them, "schemes;" and its perusal will help to clear the thoughts of a great many amongst us, who about once in a decade get bitten with the love of joint-stock and such like enterprises—and find these too often like them—or gnaw the bottoms out of their pockets in return.

We may doubt, however, that the maxims or even the reasonings of the *doctrinaire* can avail practically very far in such matters.

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*Zeitschrift des Vereines deutscher Ingenieure.*

The parts for June and July of this periodical sustain their reputation. There is a fair share of original matter, amongst which in June part is a valuable paper by Herr Dihm (*Privatbaumeister*) on the strength of rolled double T iron joists for fireproof floors &c., with good diagrams for fixing sections in relation to span and load; and the information derived at second-hand from English and other journals &c., is generally up to time.

In the July part is a pretty full and fair account of all the late steel-making processes, including Siemens', Martin's, and Heaton's.

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*A Magyar Mérnök egyesület közlönye &c., &c.* Pesth, 1868, &c.

Our readers generally will probably wonder ineffectually what this may mean. It is the same Hungarian mechanical and engineering journal published in large 8vo. at Pesth which we noticed a year or more since. It contains chiefly second-hand matter; but is a proof of the new social energy of the Magyar-land, and of the knowledge of what is going on in Western Europe which penetrates there. A technical vocabulary in Magyar and German is commenced in these last parts.

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*Besondere Vorschriften für den Baudienst der Eisenbahn von Innsbruck nach Botzen.* 1 thin vol. 8vo. Vienna, 1869.

This is an explanation of the specialities and principles upon which the various parts of these great and difficult Austrian lines over the Northern Alps have been decided upon and constructed, and is intended to go with Part VI. of Carl von Etzel's grand lithographed maps, plans, sections, and other illustrations of the Austrian railways undertaken between 1857 and 1867, of which that over the Brenner from Insbruck to Botzen is a grand example.

It says little for the information of our weekly engineering journals that none of the magnificent works executed on this line have been illustrated, we believe, as yet in their pages.

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*Bulletin de la Société de l'Industrie minérale.* 2e livraison for Oct., Nov., and Dec. 1868. Dunod, Paris. 8vo. with large folio Atlas.

This is by no means a new publication, though one, we apprehend, known to but few of our readers. It is a worthy free labourer and compeer of the *Annales des Mines*, and has now reached its fourteenth volume of four parts per annum.

To all our readers interested in mining, coal working &c., and the applied sciences on which these depend, we can recommend this periodical.

The part now before us, besides a good *résumé* from the practical standpoint of the works of the Suez Canal, contains two able practical mining papers, one by M. Chansselle on the successful damming off or plugging an underground district of the mines of Firminy by a dam under a pressure of six atmospheres of water, the other by Engineer of Mines, Levy, on sinking shafts through water-bearing strata.

There is amongst many others also an interesting theoretical paper by M. Dorlhac on the origin of rocks and the formation of veins in them, the latter a subject still very obscure, and leaving much to be wrought out from the multitudinous facts known to miners in all parts of the world.

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I. *Beiträge zur Geschichte der Chemie.* Von Herman Kopp. Erste Stücke. Braunschweig, 1869. 1 vol. 8vo.

II. *Histoire de la Chimie.* Par F. Hoeffer. 2e édit., rev. et aug. Tomes 1 et 2, 8vo. Didot, Paris, 1866–1869.

III. *A History of Chemical Theory, from the Age of Lavoisier to the Present Time.* By Au. Wurtz. Translated by H. Watts, F.R.S. Crown 8vo.

Chemistry is at length not likely to want historians. Two noble works, so far as they yet go, are named above. Hoeffer was first in this field of scientific literature, starting as long ago, in detached essays, as 1840. The history of past scientific progress presents in no department anything more fascinating than that of chemistry, emerging from the rude observations which produced the earliest arts of cooking and of dyeing and smelting, passing through alchemy and emerging into the radiant clearness and wonders of modern chemical theory and practice. In the English language, Brande, Thompson, and Whewell, with one or two others of less note, have given us histories of chemistry, or monographs, but far from complete, none showing very much erudition or devotion of labour. Gmelin, in 1809–10, produced his *Geschichte der Chemie*, but it is scarcely a work of literary scholarship or taste, however valuable as a repertory in which to identify the epoch and the men to whom all the great discoveries up to that date belonged, so far as such could be done; and, like all that Gmelin ever did, this was done well.

But Hoefer and Kopp are both scholars, full of love for old-world lore, as well as intimately acquainted with the later periods and recent progress of chemistry; and in both their works we have the most fascinating accounts of the dawn of chemical knowledge, as well as the most elaborate and painstaking research, and references without number, in verification of the vast chambers of obscurity which remain amongst the crumbling ruins of the knowledge, or the faith, or the superstitions, or of all combined, which characterised the men who first found wonders for contemplation in, and evolved real wonders out of, the crucible and the alembic. Kopp's is perhaps the more erudite of the two histories above referenced, but Hoefer's is charmingly written, and the earlier volumes ought to interest every well-educated man as a part of the history of human advancement, whether he be himself a chemist or not. We should not omit also to notice Gerding's *Geschichte der Chemie*, which appeared at Leipzic in 1867.

The venerable Mons. Chevreul, Dean of the Faculty of Sciences of Paris, has actually commenced also the production of some portions of his long-promised history of chemical science. Should he live to complete so vast a work as he has planned, there will be at

least no lack of chemical historians, and Chevreul may fairly motto the later volumes of his work, should he live to reach them, "*Quorum pars magna fui.*"

Mr. H. Watts' translation of Au. Wurtz's "History of Chemistry from the Age of Lavoisier to the Present Time" is a valued addition to English scientific history, and, like everything that Mr. Watts has done, is characterised by fidelity and laborious completeness.

The modern age, to which Wurtz limited himself, precludes mere literary interest or the charm of fancy that surrounds the history of alchemy and the elder chemistry.

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*Cours de Métallurgie générale redigé sur les notes du cours fait à l'École des Arts, Mines, etc. de Liége.* Par Aug. Gillon, Professeur. 1 vol. 8vo. with Atlas of Plates. Baudry, Liege, 1869. This is a very excellent, clear, and condensed elementary course of metallurgy. On general grounds only, it deals with furnaces, blowing machines, fuels, calcination and roasting processes, fluxes and additions in the furnace, and the mechanical preparation of minerals &c. The work would probably be worth translation into English, for we do not call to mind any elementary work in our language giving to the early student preliminary notions of practical metallurgy in as good a form. Principles and broadly applicable methods and apparatus are kept in view without encumbrance from special details, beyond what may be needful to illustration.

## CORRESPONDENCE.

☞ We do not hold ourselves responsible for the views or statements of Correspondents.

TO THE EDITOR OF THE PRACTICAL MECHANIC'S JOURNAL.

Sir,—I would not have troubled you at this time were it not to correct a wrong impression regarding Professor Smyth's governor, which I regret to see expressed in your remarks upon my letter.

I saw Porter's governor, noticed by the Professor in his very able and talented paper, working in the London Exhibition, but have not as yet seen his own; but judging from the diagram and the description given of it, I have not the slightest doubts of its merits, and I, in justice to the Professor, must say he has added somewhat to my stock of knowledge.

When I said the float would be more immediate in its action than any kind of centrifugal governor, the meaning I intended to convey was this: that the action of a centrifugal governor depends upon a preceding act of the engine; there must be a variation in its speed to change the movements of the governor before it can either give or cut off steam, however slight that variation may be, and as the waves recede from the screw they leave the engine to be regulated by its governor; but in the case of the float the action of the waves precedes that of the engine, and as they recede cut off steam proportional to their resistance before any variation can take place in the speed, and the same precedence of action to give steam will take place on the rising of the succeeding wave by opening the throttle-valve as it rises.

My former letter was rather meagre in description, my object being to state the principle of the float in as few words as possible, lest I should trespass too far upon your space. I omitted to mention that the bottom part of the tube should be bent to let the water flow in from the side, and, as you correctly observe, the entrance must be no smaller than the rest of it, or there would be loss of time.

My object in placing the tube so near the screw is that both must be in the same wave, and as near as possible at the same time in equal depth of water, and when the screw is bare the tube must be empty, with the throat down and the throttle valve shut.

Yours most respectfully,

GEORGE PRINGLE.

Prestonpans:
12th October 1869.

In theory our correspondent is perfectly correct, and we have to thank him for the very clear statement he has made of the principle which he desires to embody in governing a ship's engine. Yet whilst, no doubt, a governor operating independently of any act on the part of the engine is what is wanted to ensure perfect control, the difficulties of obtaining that desideratum with sufficient niceness and simultaneity of action with the depth of immersion of the screw, appear insuperable. We do not see, for the reasons we have formerly expressed, how the float and tube could be made a practically reliable contrivance; however, we do not wish to discourage our correspondent, still we should like to see a drawing of his plan if he can favour us with one.

V. D.

## PROCEEDINGS OF SCIENTIFIC SOCIETIES.

### THE MEETING OF THE BRITISH ASSOCIATION AT EXETER.

### SECTION B.—CHEMICAL SCIENCE.

August 19.—Dr. Debus (the President of this section), in his address, directed attention to the ideas which at present guide chemists in their researches; he placed in a clear light the objects they are striving to attain; and he indicated the direction of the scientific thought of our time.

The "Report on the Determination of the Gases existing in Solution in Well Waters," was read by Mr. H. M'Leod.

The "Report of the Committee on the Chemical Nature of Cast-Iron," was read by Mr. H. Matthiessen.

"On Electrolytic Iron," by Dr. Jacobi.

"On the Phosphorescence of the Sea and Ozone in Connexion with Atmospheric Conditions," by Dr. Moffat.—It appears from observations taken at sea that, as on land, ozone periods commence and that ozone is in maximum quantity with decreasing readings of the barometer and the conditions of the south or equatorial current of the atmospbere; and that ozone periods terminate with increasing readings of the barometer and the setting in of the polar current. Periods of luminosity of phosphorus and ozone periods take place with the conditions of the equatorial current, and that non-luminosity and no ozone periods occur with the polar current; and by tabular results he showed that the luminosity of phosphorus and the phosphorescence of the sea take place under the same atmospheric conditions, and that there is an intimate connexion between ozone periods and periods of ocean phosphorescence.

"On the Oxidation of Phosphorus, and the Quantity of Phosphoric Acid excreted by the Kidneys in Connexion with Atmospheric Conditions," by Dr. Moffat.

"On a Remarkable Structural Appearance in Phosphorus," by Professor C. Tomlinson.

Professor Calvert gave some interesting results of his experiments into the nature and condition of rust. Oxidation of the bottom of iron ships he thinks may be prevented by an external coating of a preparation of an alloy of lead and antimony, while an alkali is placed in the bilge water within the vessel.

August 20th.—"Report on the Treatment and Utilisation of Sewage," by Dr. B. Paul.

"On Extraction of Ammonia from Gas Liquor," by Mr. F. Braby.

"On the supposed Action of Light on Combustion," by Professor C. Tomlinson.

"On the Economic Distillation of Gas from Cannel Coal," by Dr. S. Macadam.

"On the Manufacture of Chlorine by Means of perpetually-regenerated Manganite of Calcium," by Mr. W. Weldon.

"On the Solubility of Lead and Copper in Pure and Impure Water," by Dr. T. L. Phipson.

"On the Measurement of Gases as a Branch of Volumetric Analysis," by Dr. W. J. Russell.

"On Jargonia," by Mr. Sorby.

"On the Amount of Soluble and Insoluble Phosphates in Wheat-Seed," by Professor Crace Calvert.

August 23.—"On the Action of Hydric-Sulphate on Phosphoric-Chloride," by Mr. S. Williams.

"On some Re-actions of Chloro-Sulphuric Acid," by Messrs. J. Dewar and G. Cranston.

"On the action of Hydrochloric Acid on Morphia and Codeia," by Messrs. A. Matthiessen and C. R. Wright.

"On the Absorption Bands of Bile," by Dr. Andrews.

"Méthode spectrale pour la recherche des composés du Sodium," by M. Janssen.

"Sur le Spectre de la Vapeur d'Eau," by M. Janssen.

"On a specimen of Obsidian from Java, with a Microscopical Examination," by Mr. W. C. Roberts.

"Are Flint Instruments of the First Stone Age found in the Drift?" by Mr. W. D. Micbell.

August 24.—On the Production of Higher Temperatures by Steam of 212° Fahrenbeit," by Mr. P. Spence.

"A Chemical Method of Treating the Excreta of Towns," by Mr. E. C. C. Stanford.

"On the Water Supplies to Plymouth, Devonport, and Exeter," by Mr. H. Bamber.

"Notes on Structural Change in Block Tin," by Dr. Fritsche.

"On Bromo iodide of Mercury," by Mr. A. Oppenheim.

"On Benzoe-sulphuric Acid," by Mr. A. Oppenheim.

"On a Method of determining with accuracy the Ratio of the Rotating Powers of Cane Sugar and Inverted Sugar," by Prof. Jellett.

"On the Registration of Atmospheric Ozone in the Bombay Presidency, and the Chief Causes which influence its Appreciable Amount in the Atmosphere," by Mr. H. Cooke.

"On the Decomposition of Carbonic Oxide by Spongy Iron," by Dr. J. L. Bell.

### SECTION C.—GEOLOGY.

August 19.—The President (Professor R. Harkness) delivered an address, which had reference chiefly to questions of local interest.

"On the Devonian Group considered Geologically and Geographically," by Mr. R. A. C. Godwin-Austen.

Mr. H. Woodward read a Report "on the Fresh-water Deposits of the Valley of the River Lea, in Essex."

Dr. P. M. Duncan read a Report of the Committee "on British Fossil Corals."

Mr. J. Thomson also read a Report of the Committee "on the Section's new photograph of corals."

"Sketch of Granite of the northerly and easterly sides of Dartmoor," by Mr. G. W. Ormrod.

"On the Source of the Miocene Clays of Bovey Tracey," by Mr. Pengelly.

"Notes on the Brachiopoda hitherto obtained from the pebble bed of Budleigh Salterton," by Mr. Davidson.

"On the Sonrce of the Quartzose Conglomerates of the New Red Sandstone of Central England," by Mr. E. Hall.

August 20.—Mr. Pengelly read "The Fifth Report of the Committee on the Exploration of Kent's Cavern, with Notes on the Mammalian Remains."

"On the Extinction of the Mammoth," by Mr. H. H. Howorth.

"On the Alleged Occurrence of Hippopotamus major and Machairodus latidens in Kent's Cavern," by Mr. W. Pengelly.

Mr. W. H. Bayley read a "Report of the Committee on the Fossils of Kiltorcan, county Kilkenny."

"On a Specimen of Teleosaurns from the Upper Lias," by Mr. C. Moore.

"On the Trappean Conglomerates of Middletown Hill, Montgomeryshire," by Mr. G. Maw.

"On Teeth and Dermal Structure associated with Ctenacanthus," by Mr. J. Thomson.

"On Reptilian Eggs from Secondary Strata," by Mr. W. Carrnthers.

"On Slickensides," by Mr. W. Carruthers.

"On the Occnrrence of Stylonurns in the Cornstone of Hereford," by Mr. H. Woodward.

"On the Discovery of a large Myriapod of the Genus Euphorbia in the Coal Measnres of Kilmanrs," by Mr. H. Woodward.

August 21.—"On the Denudation of the Shropshire and Staffordshire Coal Field," by Mr. J. Randall.

"On the Occurrence of the Mineral Scheelite (Tungstate of Lime) at Val Toppa Gold Mine, near Domodossola, Piedmont," by Mr. C. Le Neve Foster.

"On certain Phenomena in the Drift near Norwich," by Mr. J. E. Taylor.

"The Water-bearing Strata in the Neighbonrhood of Norwich," by Mr. J. E. Taylor.

"Denndation of Western Brittany," by Mr. G. A. Lebonr.

"Notes on some Granite of Lower Brittany," by Mr. G. A. Lebour.

"On some New Forms of Graptolites," by Mr. H. A. Nicholson.

August 23.—"Report of the Committee for the pnrpose of Investigating the Veins containing Organic Remains which occnr in the Mountain Limestone of the Mendips, and elsewhere," by Mr. C. Moore.

"Notes on Mr. Moore's Foraminifera from Mineral Veins," by Mr. H. Brady.

"Notice of the Discovery of Organic Remains in the Rocks between the Nare Head and Porthalla Cove, Cornwall," by Mr. C. W. Peach.

"Report of the Committee on Ice as an Agent of Geological Change," by Mr. H. Bauerman.—Mr. Bauerman thonght there was no proper means known of measuring the erosive power of glaciers.

"On the Elevation and Depression of the Coast of Greenland," by Mr. R. Brown.

"On Insect Remains and Sbells from the Lower Bagshot Leaf-Bed of Studland Bay, Dorsetshire," by Mr. G. Maw.

"On New Forms of Pteroplax and other Carboniferous Labyrinthodonts, and of Megalichthys," by Mr. J. Thomson.

"On the Discovery of Fossil Plants in the Cambrian Rocks (Upper Longmynds) near St. David's," by Dr. Hicks.

"On the Gold of Natal," by Dr. R. J. Mann.

August 24.—"Report of the Committee on Earthquakes in Scotland," by Dr. J. Bryce.

"Report of the Committee for the pnrpose of Investigating the Leaf-Beds of the Lower Bagsbot Series of the Hampshire Basin," by Mr. W. S. Mitchell.

"On the Occnrrence of a Large Deposit of Terra-Cotta Clay at Watccmbe, Torquay," by Mr. R. Etheridge.

"An Estimate of the Qnantity of Sedimentary Deposits in the River Onny," by the Rev. J. D. La Tonche.

"On the Distribntion of the British Fossil Lamellibranchiata," by Mr. J. L. Lobley.

"On Spheroidal Structnre in Silurian Rocks," by the Rev. J. D. La Touche.

"On the Distribntion of Shattered Chalk Flints and Flakes in Devon and Cornwall," by Mr. N. Whitley.

"Diamonds received from the Cape of Good Hope dnring the last Year," by Professor Tennant.

"On the Action npon Earthy Minerals and Compounds of Water in the form of Heated Steam nrged by Wood-Fnel, &c." by Mr. J. Jeffreys.

"On the Physical Canses which have produced the Unequal Distribution of Land and Water between the Hemispheres," by Mr. J. W. Reid.

"On the Crag Formation," by Mr. C. Jecks.

"Notice of Remarkable Glacial Striæ, lately exposed at Portmadoc," by Mr. J. E. Lee.

"On a Fossil Mussel-shell found in Drift in Ireland," by Mr. E. A. Conwell.

## SECTION D.—BIOLOGY.

*Department of Zoology and Botany.*

August 19.—The President (Mr. George Busk) gave no address, explaining that he had been snddenly asked to take the Presidency.

"Report of the 'Close-time' Committee," by Mr. H. E. Dresser.

"On the Effect of Legislation on the Extinction of Animals," by the Rev. H. B. Tristram.

"On the Law of the Development of Cereals," by Mr. F. F. Hallett.

"On the Flora of the Strait of Magellan and West Coast of Patagonia," by Dr. R. O. Cnnningham.

"On *Chionis alba*," by Dr. R. O. Cnnningham.

"On a lately discovered Mixogaster," by Mr. C. E. Broome.

"On the Recurrence of *Papistrum rugosum* (All.), in Snrrey, Kent, and Somersetshire," by Mr. W. D. Hiern.

*Department of Anatomy and Physiology.*

"Report on the Physiological Section of the Methyl Series," by Mr. B. W. Richardson.

"Report on the Spectroscopic Examination of Animal Substances," by Mr. E. Ray Lankester.

"The Solution of Uric Acid Calculi, and the Quantitative Analysis of Uric Acid," by the Rev. W. Vernon Harcourt.

"The Moral Imbecility of Habitual Criminals exemplified by Cranial Measurements," by Dr. G. Wilson.

The President criticised Dr. Wilson's conclusions, from which he dissented.

August 20.—"Man *v.* the Animals: being a Counter-Theory to Mr. Darwin's as to the Origin of Species," by Archdeacon Freeman.

"The Difficulties of Darwinism," by the Rev. F. O. Morris.

"Philosophical Objections to Darwinism and Evolution," by the Rev. Dr. M'Cann.

August 23.—"On the Primitive Condition of Man," by Sir J. Lubbock, Bart.

"On the Age of the Human Remains in the Cave of Cro-Magnon, in the Valley of the Vézère," by Dr. P. M. Duncan.

"On Flint Implements of Palæolithic Age from the Gravels of Ealing and Acton," by Col. L. Fox.

"On the Discovery of a Crannog in South Wales," by the Rev. E. N. Dumbleton.

"On the so-called 'Petrified Human Eyes' from the Graves at Arica, Peru," by the Rev. Dr. A. Hume.

August 23.—"On the Relations of the Fauna of British India to that of the Ethiopian and so-called Indian Regions," by Mr. M. T. Blandford.

"On the Mammalian Fauna of North-West America," by Mr. R. Brown.

"On a New Isopod from Flinders Island," by Mr. H. Woodward.

"On the Land and Fresh-Water Shells of Nicaragna, Central America," by Mr. R. Tate.

"Five Years' Experience in Artificial Fishbreeding, showing in what waters Trout *will* and will *not* thrive, with some Remarks on Fish and our British Fisheries," by Mr. W. F. Webb.

"On the Salmon Rivers of Devon and Cornwall, and how to improve them," by Mr. F. Buckland.

"On *Rhinodon typicus*, the largest known Shark," by Professor E. P. Wright.

"On a Hybrid or other variety of *Perdix cinerea* found in Devonsbire," by Dr. Scott.

"On some curious Fossil Fungi from the Black Shale of the Northumberland Coal-fields," by Messrs. A. Hancock and T. Atthey.

"On some Stone Implements from Rangoon," by Admiral Sir E. Belcher.

"On the Paucity of Aboriginal Monuments in Canada," by Sir D. Gibb, Bart.

"On the Primeval Status of Man," by Mr. W. C. Dendy.

"Notes on the Builders and the Purposes of Megalithic Monuments," by Mr. A. L. Lewis.

"On the Westerly Drifting of the Nomads from the Fifth to the Nineteenth Century," by Mr. H. H. Howorth.

"On the Origin of the Tasmanians," by Mr. J. Bonwick.

"On Voltaic Electricity in relation to Physiology," by Mr. K. Bridgman.

"On the Physiological Action of Hydrate of Chloral," by Dr. Richardson.

"On an Instrument for recording Respiratory Movements," by Dr. B. Sanderson.

"On Human Vaccine Lymph and Heifer Lymph," by Dr. H. Blanc.

"On the Myology of *Cyclothurus didactylus*," by Mr. J. C. Galton.

"On the Interpretation of the Limbs and Lower Jaw," by Professor Cleland.

"Further Observations on Dendroidal Forms assumed by Minerals," by Dr. Heaton.

August 24.—"Report on the Marine Fauna and Flora of the Sonth Coast of Devon and Cornwall," by Mr. C. S. Bate.

"On the Relative Value of the Characters employed in the Classification of Plants," by Dr. M. T. Masters.

"On the genus Boswellia, with Descri ptions and Drawings of Three New Species," by Dr. Birdwood.

"On the Whale Remains washed ashore at Babbicombe, South Devon," by Mr. W. Pengelly.

"Observations on Infusoria at Münster am Stein, Crenznach," by Mr. G. Gladstone.

"On Initial Life," by Mr. C. S. Wake.

"On the Natives of Vancouver's Island," by Dr. R. King.

"On the Esquimaux considered in their relationship to Man's Antiquity," by Mr. W. S. Hall.

"Notes on the Woolwa and Mosqnito Vocabularies," by Drs. R. S. Charnock and C. C. Blake.

"On the Human Remains in the Gravels of Leicestershire," by Dr. F. Drake.

"On a method of forming Flint Flakes used by the Early Inhabitants of Devon," by Mr. T. M. Hall.

"Notes on an Inscribed Rock," by Mr. R. Tate.

"On an Obstacle to European Longevity beyond 70 years," by Sir D. Gibb.

"On a cause of Diminished Longevity among the Jews," by Sir D. Gibb.

"On the Brain of a Negro," by Mr. R. Garner.

"On a Frontier Line of Ethnology and Geology," by Mr. H. H. Howorth.

"On the Race Elements of the Irish People," by Mr. F. H. Kinahan.

"On the Race Affinities of the Madecasses," by Mr. C. S. Wake.

"On the Races of Morocco," by Mr. J. Stirling.

"On the Homologies in the Extremities of the Horse," by Mr. R. Garner.

"On the Connexion between Chemical Composition and Physiological Activity," by Professor Crum Brown.

"On Sleep and Anæsthetics," by Dr. Kidd.

### SECTION E.—GEOGRAPHY.

August 19.—The President (Sir Bartle Frere) said that it was not his purpose to review the progress of Geography since the last meeting of the Association, and he therefore contented himself by giving an outline of the subjects expected to be brought before the Section during the sittings.

"Erskine's Discovery of the Mouth of the Limpopo," by Dr. R. J. Mann.

"Plan of a Canal to unite the Upper Nile with the Red Sea," by Charles T. Beke, Ph.D.—The proposed Canal was along the line of a natural water-course south-west to north-east, between the 16th and 19th parallels of north latitude, and its operation would be to convey a portion of the waters of the Atbara into the Red Sea, at a short distance to the south of Sowakin.

"A Visit to the Holy City of Fas, in Morocco," by Mr. J. Stirling.

"Notice of a Bifurcate Stream at Glen Lednoch Head, in Perthshire," by Capt. T. P. White, R.A.

"Notes on a Recent Visit to the Suez Canal," by Capt. C. Dodd.

"On a Small Altazimuth Instrument for the use of Geographical Explorers," by Lieut.-Col. A. Strange.

August 20.—"On the Runn of Cutch and the Countries between Rajpootana and Sind," by Sir Bartle Frere.

"On the Latitude of Samarcand," by M. Nicholas de Khanikof.

"On Central Asia," by M. de Tchihatchef.

"On the Encroachment of the Sea on Exmouth Warren," by Mr. G. Peacock.

"On the Kitai and Kara Kitai," by Dr. Gustav Oppert.

"Notes on the Runn of Cutch," by Capt. C. Dodd.

August 22.—"On the Straits of Magellan and the Passages leading Northward to the Gulf of Penas," by Capt. R. C. Mayne, R.N.

"On the Distribution of Heat on the Sea Surface throughout the Globe," by Admiral Sir E. Belcher.

"On the supposed Influence of the Gulf Stream on the Climate of North-Western Europe," by Mr. A. G. Findlay.

"On the best Route to the North Pole," by Captain R. V. Hamilton, R.N.

"Peruvian Explorations and Settlements on the Upper Amazons," by Mr. F. F. Searle.

"On Extraordinary Agitations of the Sea," by Mr. R. Edmonds.

August 23.—"Account of Mr. Cooper's Attempt to reach India from Western China," by Mr. T. Saunders.

"On Trade Routes between Northern India and Central Asia," by Mr. T. D. Forsyth.

"On the Himalayas and Central Asia," by Mr. T. Saunders.

"Scheme of a Scientific Exploration of Australia, from East to West," by Dr. G. Neumeyer.

"Notes on a Journey in Northern Abyssinia," by Mr. W. T. Blandford.

"On the Geography of the Frankincense-plant," by Dr. G. Birdwood.

"On the Existence of Sir W. Raleigh's El Dorado," by Dr. C. Le Neve Foster.

### SECTION F.—ECONOMIC SCIENCE AND STATISTICS.

August 19.—The President (the Right Hon. Sir Stafford Northcote), in the course of his address, said that the statist was not animated by a mere spirit of curiosity, nor did he content himself with the mere accumulation of facts; his objects were at once nobler and more practical; he aimed at discovering the actual condition of his country, and the causes of that condition, with a view to discover also the methods of improving it.

"On the Maintenance of Schools in Rural Districts," by Canon Girdlestone.

"On the Technical Education of the Agricultural Labourer," by Mr. B. Denton.

"Remarks on the Need of Science for the Development of Agriculture," by Messrs. J. H. Holley and Dr. Mann.

"On the Sutherland Gold Diggings as a Scientific and Social Experiment," by Dr. L. Lindsay.

"On the Decline of Shipbuilding on the Thames," by Mr. J. Glover.

August 20.—Professor Leone Levi presented the "Report of the Committee on the Uniformity of Weights and Coins in the interest of Science."

"On International Coinage," by Dr. Farr.

"On Weights and Measures," by Mr. W. H. U. Sankey.

"On the Economic Condition of the Agricultural Labourer in England," by Professor Leone Levi.

"On Agricultural Economics and Wages," by Prof. Leone Levi.

"On the Examination Subjects for Admission into the College for Women at Hitchin," by Mr. J. Heywood.

"On the Method of Teaching Physical Science," by the Rev. W. Tuckwell.

"Some Statistics of the National Educational League," by Mr. J. Collings.

"Some Statistics of Railways in their relation to the Public," by Mr. R. Brandon.

"Contributions to Vital Statistics," by Dr. J. Stark.

"Vital Statistics of Bombay," by Mr. P. M. Tait.

"On Naval Finance," by Mr. R. Main.

"On the Want of Statistics on the Question of Mixed Races," by Dr. Hyde Clarke.

"On the Rapidity of Human Thought," by Dr. Hyde Clarke.

"On the Distinction between Rent and Land Tax in India," by Dr. Hyde Clarke.

August 23.—"On the Pressure of Taxation upon real Property," by Mr. F. Purday.

"On Local Taxation in Ireland," by Dr. W. N. Hancock.

"On the Condition of the Agricultural Labourer," by Mr. W. Botley.

August 24.—"On Assisted Emigration," by Dr. R. Mann.

"On the Economic Progress of New Zealand," by Mr. A. Hamilton.

"On Municipal Government for Canadian Indian Reserves," by Mr. J. Heywood.

"On Prison Laws as Associated with Prison Discipline," by Sir J. Bowring.

"On our National Accounts," by Mr. F. P. Fellowes.

"On the Devonshire Association for the Advancement of Science, Literature, and Art," by Sir J. Bowring.

"On the General Mortality in the Town and Rural Districts of Scotland," by Dr. J. Stark.

August 25.—"Statistics of Invention, Illustrating the Policy of a Patent Law," by Mr. H. Dircks.

## THE LONDON ASSOCIATION OF FOREMEN ENGINEERS.

A very numerously attended meeting of members of this institution wae held on Saturday, the 2nd ult., at the City Terminus Hotel. Mr. J. Newton, of the Royal Mint, presided on the occasion. The business of the evening commenced, as usual, with the election of new associates, and among these was Mr. Yeats, foreman of the foundry in her Majesty's dockyard, Bombay. It was next arranged that the members should pay a collective visit of inspection, on Saturday, the 16th inst., to the Abbey Mills Pumping Station of the Metropolitan Main Drainage Works, for which Mr. Bazalgette had kindly accorded permission.

Mr. Nicholson, of the Blackwall Ironworks, Isle of Dogs, then read a paper on "A Continuous Expansion Steam-Engine," an invention of his own. After some preliminary remarks, the author went on to say that after Watt had converted the reciprocating motion of the steam-engine into a rotary motion, his next step was to endeavour to effect economy by cutting off the steam at an earlier part of the stroke, and this plan was now known as the Cornish principle. This was followed by Wolff's arrangement of a double cylinder engine and certain modifications of the same by other engineers. Of the Cornish principle he (Mr. Nicholson) should observe that it was far from being perfect. It ensured the taking of all the useful effect out of the steam, but it produced a motion in an inverse ratio to its expansion, and which was therefore inapplicable for many purposes. Wolff's engine he considered to be decidedly better both as regarded economy and action. The continuous expansion engine he believed would be found superior in all ways to both. It was applicable to marine, stationary, and locomotive purposes, and more especially so to the first named. There was very little difficulty in modifying existing marine engines so as to embody in them the continuous expansion system. He proposed to employ two cylinders in all cases, and sometimes three, or even four. In this class of engine no secondary steam was used, the energy of the steam, so to speak, being eliminated in little more than half a revolution, whilst no cut-off valves were needed. The defective link motion was avoided. By this arrangement, too, a better rotary motion was obtained than by any other known means, and a full practical range of expansion ensured the highest degree of economy. In the Wolff's engines the effective working area was equal to the difference of the areas of the two pistons, and if the cylinders were made of the same diameter therefore those engines would be found comparatively useless. In such case the mean pressure on the one piston would be found just equal to the mean resistance on the other. This would not be so with the continuous expansion engine, for if the pistons were made of equal area the result would be found thoroughly satisfactory. By cutting off the steam at five-eighths of the stroke in the first cylinder that cylinder did an ordinary duty, and the residue of the steam was worked up in the second or expansion cylinder, thus producing a smooth motion and a maximum of power with a minimum consumption of fuel. The most practicable and efficient way to expand steam was to terminate the stroke at a pressure that would yet do a little more work and then balance the useless resistance. If this theory were true, the continuous expansion engine possessed manifest advantages, because the piston of the first cylinder or cylinders that receives the steam from the boilers were in the most powerful position, and could afford to allow of a higher rate of expansion than could be profitably effected in a single cylinder expansion engine.

The whole of Mr. Nicholson's proposed improvements in the steam engine were made clear by the aid of numerous diagrams, and it was also mentioned that they are embodied in the engines of the steam-tug *Era* now employed on the river Thames. Some rather sharp comments upon the extravagant (as Mr. Nicholson thought) consumption of fuel in ships of the Royal Navy and the necessity of checking it brought the paper to a close.

In the lengthened discussion which followed it, Messrs. A. Watkins, Briggs, Irvine, Thorburn, Randall, Ives, Gibbon, and the chairman took part, Mr. Nicholson replying satisfactorily to some objections raised.

In submitting a vote of thanks to the author of the paper, the chairman took occasion to say that he, in common, he was sure, with every member of the association felt gratified in the highest degree to find the Government recognising the eminent services of Mr. Whitworth and Mr. Fairbairn. In the conferring of baronetcies upon those gentlemen, who had risen by their own exertions and merit from humble positions in the mechanical ranks of the community to their present exalted sphere, honour had been reflected upon every engineer and mechanic in the kingdom. He wished, therefore, on behalf of the association as well as on his own account, to give expression to the pleasure and gratification they all felt at the conduct in this instance of Mr. Gladstone, and of the hope they had that Sir Joseph Whitworth and Sir William Fairbairn might long be spared to enjoy their well-earned dignities. He wished, too, that Mr. J. Penn had received a similar distinction. These remarks were well received, and the vote of thanks to Mr. Nicholson having been unanimously carried, the proceedings terminated.

## IRON AND STEEL INSTITUTE.

This Institute held its first Annual Meeting on the 22nd of September last, at Middlesborough.

The Royal Exchange was made available for members as a general reception-room, post-office, telegraph-office, &c. In the same hall arrangements were made

for the exhibition of models, specimens, diagrams, and other objects of interest to the iron and steel trades.

Papers were read—

"On the Development of Heat and its Appropriation in Blast Furnaces of Different Dimensions," by Mr. Isaac Lowthian Bell, Newcastle, vice-president.

"On Siemens's Regenerative Furnace, and its application to Re-heating furnaces connected with Rolling Mills," by Mr. Josiah T. Smith, Barrow-in-Furness, vice-president.

"On the Manufacture of Rails," by Mr. Edward Williams, Middlesborough, member of council.

"On Iron as a Material for Shipbuilding, and its consequent influence on the Armament and Commerce of Nations," by Mr. C. M. Palmer, Newcastle.

"On the Siemens-Martien Process of Manufacturing Steel," by Mr. R. Howson, Middlesborough.

"Description of a Hot-blast Fire-brick Stove," by Mr. T. Whitwell, Stockton.

"On the Production and Application of Combustible Gases under Pressure," by Mr. G. H. Benson, Staleybridge.

"On a New Process of Refining Iron," by Mr. J. Palmer Budd, Ystalyfera.

## MONTHLY NOTES.

LEPAN'S APPARATUS FOR COVERING TELEGRAPH WIRES.—The annexed engravings illustrate an apparatus designed by M. T. Lepan, wire manufacturer, of Lille, for the purpose of covering telegraph and other wires. It occurred to Mr. Lepan, seeing the inefficiency of the galvanising method, that if the iron wire were covered with a leaden tube, applied in such a manner as to be perfectly united to it, and to be capable of bending freely with it, it would preserve the iron from oxidation, and at the same time be much more durable and more economical than galvanised iron. He has, therefore, devised a means of applying the leaden coating to the wire, which he employs as a moveable mandrel, and passes it through a suitable apparatus, its motion being determined by the efflux of a mass of lead in a semi-fluid state through an orifice in the centre of which the wire is disposed. C (fig. 1) is a cylinder, in which is situate a hollow piston P, which compresses the lead; the iron wire F, after having traversed the piston P through an opening O, enters a tube which occupies the centre of the cylinder, and is intended to separate it from the lead until it reaches the outlet orifice. The tube T is screwed into the ring A, in which are formed four orifices *a* (fig. 2), to admit of the passage of the lead. In front of the tube T there is also screwed into the ring A a piece D, which has a hole drilled in it of the same size as the wire, and is turned on the outside to the concave form shown in fig. 1. Another ring B is provided in front of the ring A, having a hole in it which determines the diameter of the protecting leaden tube, but which increases in size as it extends backwards and assumes a funnel shape, so that at its back face its diameter is equal to that of the cavity L of the ring A. The apparatus operates in the following manner:—The lead contained in the cylinder C flows out through the orifice formed in the ring D, and by reason of the contraction it undergoes in passing through the aperture, in consequence of the diminishing size of the latter, the lead exercises a pressure upon the iron wire which is thus fed along with it. It will thus be seen that the protective covering is produced of the same length as the wire, and in a continuous manner; the thickness of the lead may also be varied by changing the ring B and varying the diameter of the orifices, to suit the thickness that it is desired to obtain. The size of the iron wire may also be reduced by substituting for the piece B another with a hole of the required diameter. A similar result could be obtained by drawing a ring of lead over an iron wire, but in this case the leaden covering would be limited in length, whilst by the method we have described its length is unlimited. Mr. Lepan exhibited in the Paris Exhibition about 23 yards of wire produced by the aid of this apparatus, together with other remarkable specimens of tubes manufactured by him.—*Le Génie industriel.*

Fig. 1.

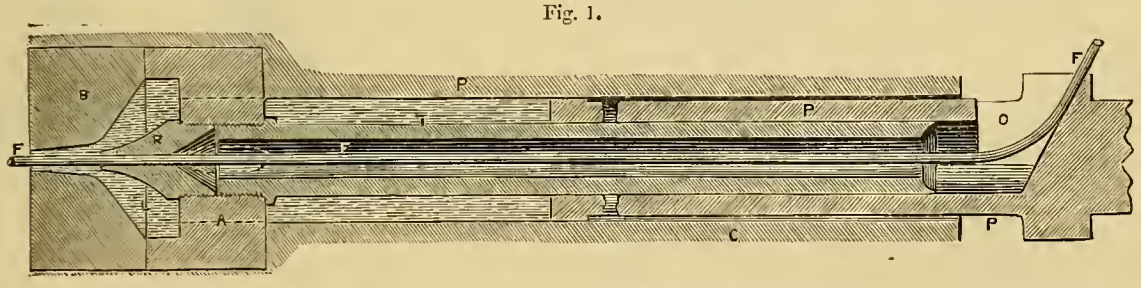
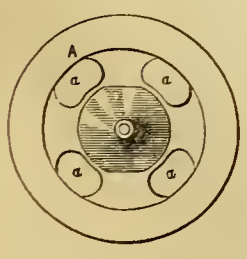



Fig. 2.

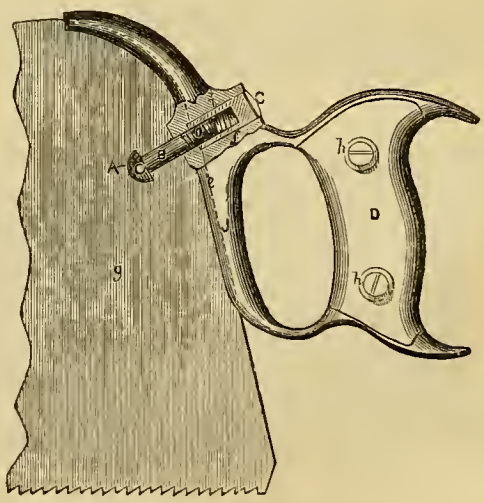



THE FRENCH COAL AND IRON TRADES.—The French Iron trade displays continued activity, but prices have presented no material change. There has not been much doing in rough pig at St. Dezier, but other descriptions have been sought after to a considerable extent. The works of the Menrthe and the Moselle are even better off than those of the Haute-Marne, in consequence of the regular demand which they experience, while prices are steady and firm as a matter of course. Among items of French metallurgical intelligence may be mentioned the re-lighting of the Frouard furnace for the production of refining pig, the renting of the Heming Works by M. Lemmonnier, a proposal to sell the Moulaine furnaces, and an abortive attempt to sell the St. Charles forges in the Ardennes, the reserve price of £7,600 not having been attained. A fresh attempt will, it is said, be made shortly to sell these last-mentioned works. The Belgian iron trade displays no material variation; puddled bars have, however, become scarce, and have commanded high rates. Official tables show that the exports of rails from Belgium in the first quarter of this year amounted to 17,916 tons, against 14,804 tons in the corresponding quarter of 1868, and 22,725 tons in the corresponding quarter of 1867. The demand for Belgian rails in Russia seems to have rather declined this year. The Belgian coal trade does not exhibit much change; the demand is tolerably well sustained, especially for coal for industrial purposes.

NEW IRONCLADS.—The following armour-clad ships are now under construction for the Admiralty either at the Royal dockyards or private shipbuilding establishments. They are said to be in such a forward state that they will be completed during the present or early in the ensuing year:—The *Sultan*, 12, 5,226 tons, 1,200-horse power, and the *Glatton*, 2, 2,709 tons, 500-horse power, double screw turret-ship, building at Chatham dockyard; the *Iron Duke*, 14, 3,774 tons, 800 horse power, double screw, building at Pembroke dockyard; the *Swiftsure*, 14, 3,893 tons, 800 horse power, and the *Triumph*, 14, 3,893 tons, 800 horse power, building by the Palmer Shipbuilding Company at Jarrow-upon-Tyne; the *Hotspur*, 2, 2,637 tons, 600 horse power, armour-plated ram, building at the yard of Messrs. Napier and Sons, Glasgow; and the *Vanguard*, 14, 3,774 tons, 800-horse power, building by Messrs. Laird Brothers, Birkenhead. In addition to the above the *Abyssinia*, 4, 1,854 tons, 200 horse power, and the *Magdala*, 4, 2,107 tons, 250 horse power, double screw iron armour-plated turret-ships, are building for the defence of Bombay, the former by Messrs. Dudgeon at Poplar, and the latter by the Thames Iron Shipbuilding Company at Blackwall. As soon as one of the building slips becomes vacant at Chatham dockyard a new armour-plated ram, to be named the *Rupert*, of 3,159 tons and 700 horse power, is to be commenced at that establishment. A new armour-plated turret-ship, the *Devastation*, of 4,406 tons and 800 horse power, from the designs of Mr. E. J. Reed, C.B., has been recently commenced at Portsmouth dockyard.

SAW HANDLES.—The improvements in saw handles, and the method of attaching the same to saw blades, illustrated in the annexed engraving, are the invention of Mr. C. W. Hubbard of Pittsburg, in the United States of America.

The engraving is a side elevation showing the improvement in saw handles, and representing also the manner of securing the same to the saw blade; *g* represents a portion of an ordinary saw blade furnished with a slot A, which in form and size corresponds to the form and size of the bolt B, one end of which is provided with




screw threads *o*, to which is fitted a screw nut *c*, which is placed in a recess *f*, made in the part *i* of the handle J. The back end of the saw blade *g* is fitted into a groove made in the front end of the handle J, as indicated by the dotted lines marked *e*. The part D of the handle which is grasped by the hand of the operator is formed of wood, and is secured to the metal part J by means of screws or rivets *h*. The effect of these arrangements will be obvious.

HOLLOW BRICKS OR BLOCKS.—The improved hollow bricks or blocks illustrated in the annexed engravings are the invention of M. François Louis Sabront, of Paris, and are intended to be used in substitution for ordinary lath and plastering for the floors, ceilings, and other parts of buildings. Panelled bricks composed of plaster and other substances substituted for the lath work of ceilings and floors, and for the construction of slight partitions, have hitherto been made in moulds containing cores intended to produce the hollows or cavities, such cores being subsequently withdrawn through one of the faces of the panel, which remains open, and which is subsequently closed by placing the panel vertically in a second mould. One part of M. Sabrout's improvements consists in substituting for the ordinary wooden mould used for closing the hollow bricks a single piece composed of a flexible and elastic material, such as caoutchouc. This piece, the internal form of which is identical with the external form of the sides of the brick, carries three projections, which penetrate into the interior of the plaster or other material used, and form openings or air-holes to facilitate the drying and the removal of the piece from the mould. Into these holes also the plaster or other substance used for forming the joint penetrates, thus firmly uniting all the pieces composing the flooring so constructed; by which its strength is greatly augmented. The use of a flexible substance offers greater facility in the manufacture of hollow panelled bricks than wooden moulds, for the reason that the substances employed are capable when setting of increasing their volume without inconvenience, as the mould itself yields under the internal pressure. Another object M. Sabrout has in view is to dispense with the second operation in the ordinary process of manufacture, viz. the closing of the hollow brick or panel after it has been run into the mould. Fig. 1 of the engravings is a transverse vertical section of the mould employed for closing the panelled bricks; fig. 2 a longitudinal section of the core employed; fig. 3 a transverse section of the core and mould; fig. 4 a longitudinal section taken through the centre of fig. 5, which latter is a part plan and part longitudinal section taken through the centre of fig. 4. The moulds *c* are composed of wood or metal, and formed of several parts united together, into which the plaster or other materials intended to form the hollow bricks is run; *d* are the cores, composed of plaster or of other light and cheap material, which are left in the interior of the bricks; *e* are wood or metal rods supporting the cores *d*; *ff* are the hollow panelled bricks in the process of manufacture; and *gg* are handles provided to facilitate the handling of the moulds.

Fig. 1.

Fig. 2.

It is sufficient when running the plastic material into the mould to maintain the latter between wooden cross-pieces disposed for that purpose. In dispensing with the second operation in the ordinary process of manufacture, viz. the closing of the hollow brick or panel after it has been run into the mould, M. Sabrout disposes in the mould *c* a series of cores *d*, of a slightly conical form and light, but sufficiently strong, and which cores, after the operation, remain embedded in the substance of which the hollow panel block or brick is made. These cores *d* should therefore be made of a light and inexpensive material, and plaster or the same substance of which the hollow panel is composed is by preference employed. In order to make these cores, a coarse cloth, such as canvas, is laid round a smooth wooden or metal mandril, previously greased or soaped, and on this cloth is spread, either with a brush or with the hand, a layer of plaster, about 1/16th to 1/8th of an inch in thickness. By this means a core is obtained closed on five sides, and it is simply requisite to close the side left open for the withdrawal of the mandril by a cover of wood or plaster previously prepared and fixed to the core by a layer of the same substance as is used to form the core, with or without the use of a piece of cloth to increase the strength of the whole. The core thus manufactured is provided with apertures at both ends, intended to receive the wooden or metal rods *e*, which pass through the sides of the detachable mould *c*, and maintain it firmly in the position it is required to occupy. The cores are disposed in a parallel manner in the mould, as shown in fig. 5, but they may also be arranged so that the larger end of one core may correspond to the narrow end of the next; the spaces between the cores will then be of the same dimensions, and the strength of the hollow panels equal and uniform. In order to remove the panel from the mould, the rods *e*, which maintain the cores in their place, are withdrawn, and the sides of the mould *c* removed. The mould is for this purpose so constructed as to render it capable of being taken to pieces and put together again with great facility, and is provided with handles, which admit of the two longitudinal faces of the mould being simultaneously either brought into closer proximity or separated, and when so separated the hollow-moulded panel will leave the mould without difficulty. It will be understood that the rods e when withdrawn leave apertures which form air-holes, and which, when the panels are united, admit of the entrance of the plaster or other material used in forming the joint, which renders the junction firm and strong when these hollow panels are employed for flooring or partitions.

FIG. 4.

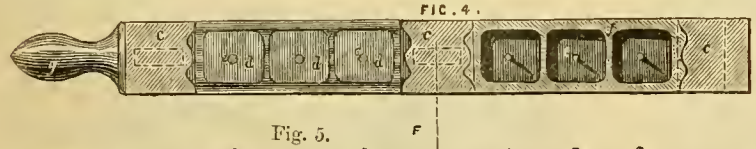


Fig. 5.

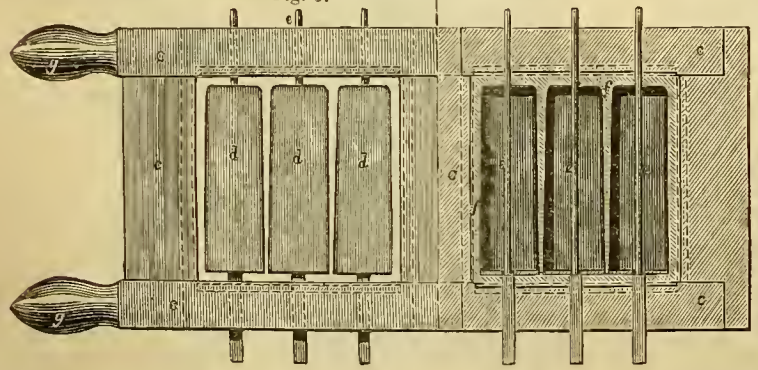
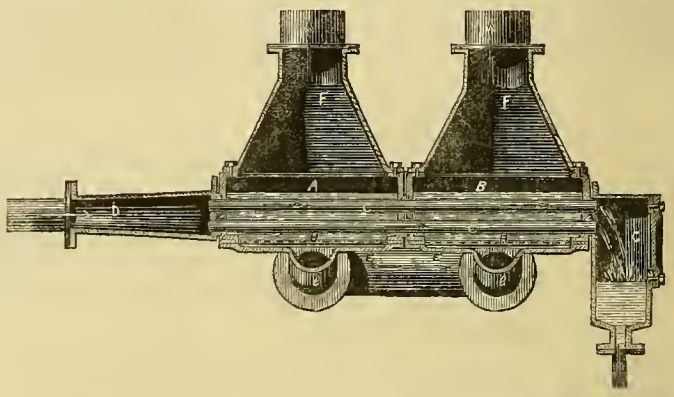


Fig. 3.

Any light or inexpensive material may be employed in the manufacture of the cores, such as pasteboard, for example; the main feature of the improvement consisting in leaving in the interior of the hollow panelled brick, in the process of manufacture, light and cheap hollow cores, by which the operation of closing the panel, which in the ordinary way is closed only on five sides, after it has been run in the moulds provided with mandrils, is dispensed with.

HYDRO-ATMOSPHERIC CONDENSER.—The condenser represented in the accompanying engraving is the invention of M. Placide Nezeraux of Paris, and is designated by him a "hydro-atmospheric condenser." The objects M. Nezeranx had in view in arranging this condenser were—effecting a considerable economy in the quantity of refrigerating water or liquid required, and affording facility for applying the condenser to steam-engines of every kind. The essential feature of the invention consists in carrying off the heat from the refrigerating water or liquid as fast as it is imparted thereto by blowing or otherwise causing cold atmospheric air to pass through it. The apparatus may be constructed in various forms, so as to render it applicable to different forms and constructions of engines, and to different purposes where a condensing or cooling effect is required.

The accompanying engraving is a longitudinal vertical section of one form of the "hydro-atmospheric condenser" disposed horizontally. It is composed of two shallow cast-iron vessels or cisterns A B, traversed from end to end by tubes C; these



cisterns are filled with water to a certain height so as to completely cover the tubes, which terminate at one end in a chamber D, where the steam arrives from the eduction port, and at their other end in a receptacle G, containing the water of condensation.

The bottom E of each cistern is moveable; it has cast on it a tube *e*, which conducts the air supplied by any convenient force-pump and is covered by a false bottom H, composed of sheet-iron or copper, perforated with holes for the passage of the air. On the top of the two cisterns are disposed receivers F, of cast or sheet-iron, with which pipes communicate to conduct the hot air, which is more or less saturated with water, either into the atmosphere or into the furnace of the boiler in order to accelerate combustion.

The apparatus operates in the following manner:—The steam from the eduction port enters through a pipe into the chamber D, and thence passes into the tubes C, as indicated by the black arrows, where it is condensed and runs off in the form of water into the receptacle G. The water contained in the cisterns A, B absorbs the heat of the steam, and occasions its condensation; this water is not renewed, but is deprived of the heat which it receives from the steam by a blast of air. The air is forced by a pump into the space which exists between the bottoms E and the false bottoms H; the latter, being perforated with holes or made of wire gauze, offers a passage to the air, which penetrates into the mass of water contained in the two cisterns and extracts the heat from the water, and then escapes through the receivers F and the pipes attached thereto, as shown by the arrows. It is necessary to regulate the admission of the air into the first cistern A, in order to maintain the water which it contains at a sufficiently elevated uniform temperature. For this purpose the pipe *e*, which appertains to this cistern, is provided with a butterfly valve, the position of which is adjusted by means of a lever, or by any other means. The air, however, enters in a full current into the second cistern B, the temperature of the water of which requires to be lowered as much as possible.

IMPROVED REELS OR BOBBINS.—The ordinary wooden reels or bobbins at present in use possess the disadvantage of being unnecessarily heavy, and the object of the inventor (M. Paturean, of Paris) of the improved reels or bobbins now

under notice is to replace them by lighter ones. M. Paturean's bobbin is composed of cardboard, pasteboard, or other fabric capable of being shaped by dies and matrices in a stamping press.

The improvements which have been introdnced in the mannfacture of pasteboard by machinery admit of the manufacture, by the aid of dies and matrices or monlds, of shells snitable for making bobbins stamped ont of pasteboard, with or without a flange, presenting the appearance, as they are delivered from the stamping machine, nf a base or bottom with an elongated tnbe. The improved bobbins are constructed, according to one method, of two of snch shells only, provided with elongated tubes fitting the one into the other. According to another mode of manufacturing pasteboard bobbins it is proposed to place over the tube of the bobbin, which is cylindrical and without a flange, two of the improved stamped-ont shells above described, which fit over the plain cylinder at each end and meet in the centre thereof, thereby prodncing a complete bobbin, which is eqnal in strength to that obtained by the first mode of manufacture hereinbefore described. This second type of bobbin is specially applicable to reels or bobbins of large diameter which require to be of great length.

Fig. 1 of the accompanying engravings shows the two stamped-out shells *a a'* of a bobbin of the first type, separate or before being nnited together. Fig. 2 shows the

Fig. 1.

Fig. 3.

Fig. 2.

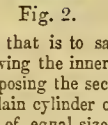
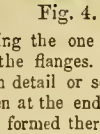


Fig. 4.



bobbin complete, that is to say, with the shells fitting the one over the other; the dotted lines showing the inner shell. *b b'* represent the flanges. Fig. 3 shows the three parts composing the second type of bobbin in detail or separate, snch parts consisting of a plain cylinder or tnbe *c*, closed or open at the end, and two stamped-ont shells both of equal size *a a'*, with flanges *b b'* formed thereon. Fig. 4 shows the same parts united together, and forming a complete bobbin of the second type; the dotted lines representing the internal tnbe or cylinder *c*, and the line *d* indicating the jnnction between the two ends of the shells *a*. Gnm or other snitable cement may be used for secnring the parts together after they have been united.

Manufacture of Spoons, Forks, and Ladles.—The improvements about to be described are the invention of Mr. Thomas Bennett of Birmingham, and were the subject of letters patent granted a short time since to that gentleman. The improvements have reference to the mannfactnre of spoons, forks, and ladles, and are applicable also to the making of handles from sheet or hoop-iron, or other sheet metal, whereby such articles may be prodnced at a cheaper rate and more expeditiously than heretofore.

Mr. Bennett employs snitably-shaped rolls having respectively formed on them projections and recesses for rolling a longitudinal hollow head along the centre of the narrow part of the blank from which a spoon, fork, or other like article is to be subsequently mannfactnred, for the pnrpose of strengthening the same; such hollow bead heing made to terminate in the bowl of the spoon, or to extend into the bend of the forks, as the case may be, whereby additional strength is obtained. One of the said rolls has a portion of its periphery removed in order to leave a space between the twn rolls for the insertion of the metal blank to be corrugated, snch blank being passed between the rolls and bronght np to an adjustable stop or gauge. As the rolls revolve, or partially revolve, as the case may be, these projections and recesses

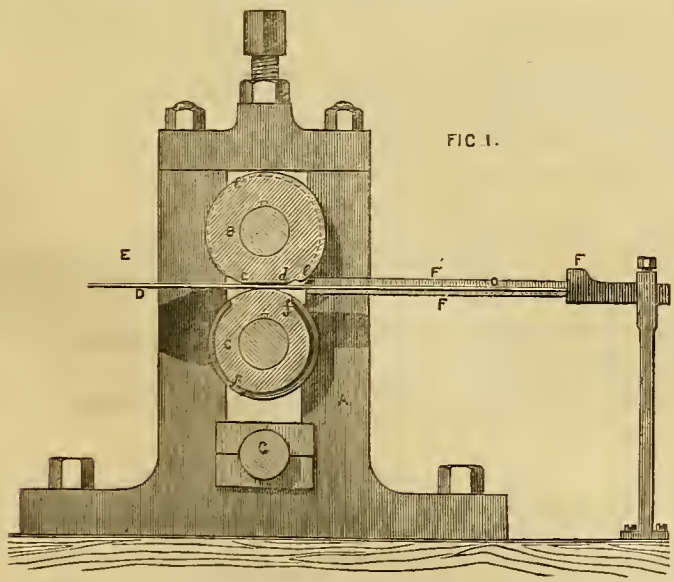
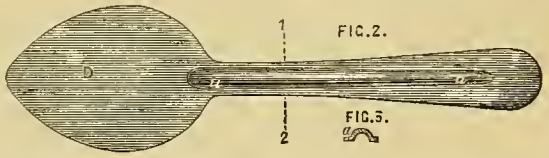



FIG 1.

meet together and prodnce a hollow bead along the narrow part of the blank. He sometimes prepares hoop or sheet-iron or other sheet metal, intended to be subsequently mannfactured into spoons, forks, and other like articles, by rolling longitudinal hollow beads therein at snitable intervals before it is cnt into blanks by passing the metal throngh a pair of rolls provided with corresponding projections and recesses of the reqnired dimensions. These strips or sheets of metal are subsequently cnt into blanks of the desired form, leaving the hollow bead or corrngation in the centre of the narrow part intended to form the handle of the spoon or other like article in order to increase the strength thereof. The projections and recesses on the rolls above referred to may be made in separate pieces of steel or chilled iron fitted into the rolls themselves, so as to be removable when injured, or when required to be replaced by others of different forms or dimensions. The metal may be rolled either in a hot or cold state as found most desirable in practice.

Fig. 1 of the engravings is a transverse vertical section of a pair of rolls for rolling a hollow bead, or corrugation, along the centre of the handle of a spoon, fork, or other like article. Fig. 4 is a view of a spoon blank, after the longitudinal hollow bead has been rolled thereon; and fig. 3 is a transverse section of the handle, showing clearly the form of the hollow bead. On referring to fig. 5, it will be seen that the hollow bead *a* extends some little distance into the bowl *b* of the spoon, as shown by the dotted lines, whereby considerably more strength is obtained than when the hollow bead terminates before reaching the bowl. In fig. 1 A represents the two standards of the pair of rolls or rolling-mill, provided with the usnal adjustable bearings, and containing two rolls B and C, which may be either solid with their journals, or fitted thereon by a nut and screw thread; or by any other snitable contrivance which will admit of the rolls being easily removed from the said journals, and replaced by others when requisite. A portion of the periphery of one of these rolls, say from *c* to *d* in the roll B, is cut away, as shown, in order to allow of the free introduction of the blank D between the rolls when the rolls are in a suitable position for commencing their work. Upon the upper roll B there is formed a tapered projection *e e*, extending more or less round the snrface of the roll, according to the desired length of hollow bead to be rolled in the blank. The transverse contour of this projection *e* should correspond to the transverse contour of the concave portion of the bead throughout its entire length. On the roll C a corresponding groove *f f* is sunk, the transverse contour of snch groove




corresponding with that of the convex or external portion of the bead to be produced. The blank is inserted between the rolls from the side marked E, its front end being brought against an adjustable guide or stop F, which regulates the position at which the projection and hollow on the respective rolls commence to operate upon the blank. F' is a trough or gnide with raised sides, for the purpose of guiding the blank during the process of rolling and curving, the hollow bead being rolled along the centre line of the blank. On imparting a rotatory motion to the rolls, the hollow longitudinal bead on the blank will be rolled, and the finished blank delivered back or returned to the hand of the operator at E. In lieu of rolling a continuous hollow bead along the narrow part of the blank, or in a strip or sheet of metal intended to be subsequently cut np into blanks, the inventor sometimes rolls a disconnected series or row of circular or other shaped indents along such blanks, or in snch strip or sheet of metal before it is cut up into blanks, the form of the rolls being of course modified to suit the indentations to be prodnced.

Styrian Steel.—Two years ago the Austrian Government forwarded some samples from their steel manufactory to this country, which were prononnced by Birmingham and Sheffield manufacturers as regards quality to be as good, if not better, than the Swedish steel, and far cheaper in price. The chief drawback to its export has been that Austria could not produce sufficient qnantities, and that the freight was too high through the insufficiency of railway communication. The Neuberg and the St. Egydi Kindberger Steel manufactories have now been transferred to two joint-stock companies. The purchase money for the first was snbscribed for by a committee of Anstrian and English gentlemen, among the latter Mr. Thomas Brassey; the money for the second was contribnted by a large nnmber of shareholders, at the head of which stands the Anglo-Austrian Bank. Although these two manufactories are supplied for years with orders for the home trade, large preparations are being entered into, so that in a year or two, when all the branch lines, inclnding the Rndolf Railway, shall have been completed, fresh trials will be made to export to England quantities of Styrian steel, which, it is stated, was in the middle ages considered superior to any in Europe.

Oil Painting upon Zinc.—Every painter is aware of the difficulty experienced in making oil colours adhere to articles of sheet zinc. Professor Boettger, however, has recently published a process by which it is stated that the desired resnlt can be accomplished, this process consisting in the previous application, by means of a hard brush, of a mordant, composed of one part of chloride of copper, one part of nitrate of copper, one part of sal-ammonia, and sixty-four parts of water, to which is afterwards added one part of hydrochloric acid. The zinc turns of a deep black immediately after the application, changing after drying (12 to 24 hours) tn a dirty black greyisb-white shade, npon which any oil colour, once applied, will adhere with the greatest tenacity.

National Elementary Education.—An inspection lately took place at the North Surrey District Schools, Anerley, of the orphans and destitute children there educated. The inspection was made at the instance of the Council of the Society of Arts for the purpose of displaying by example the effect of mixed mental, physical, and indnstrial training on the half school-time principle of instrnction. The school is one of the class of districts of Poor-Law Unions to which orphan and destitute children who are chargeable on the poor-rates are sent. The physical and industrial training begins in the infant school. When abont nine years of age the children are taught military drill, school gymnastics, elementary drawing and singing. The managers of the school claim for it the merit of an example of an organisation of teaching power which is applicable to the greater part of the country, by which better elementary instrnction, in half the time devoted to it, is

given in half the nnmber of years, so as to give the wage classes as good elementary instrnction by the 11th year as is now commonly given by the 13th year. This result is obtained at less expense. It also appears that the health of the children bronght up in the institution is very far superior to that of the children of the independent poor, and of the general community. The buildings and grounds occupy more than fifty acres, which is divided into garden, meadow, and arahle land, on which the children are employed. The buildings consist of school and class-rooms, play and sleeping-rooms, engine-room, workshops, infirmary, farm-buildings, gas-works &c., and are capable of accommodating 860 inmates. Children are admitted at the age of two, and are divided into three classes—viz., infants from 2 to 7; girls, 7 to 16; hoys, 7 to 16. The instrnction and training consists of reading, writing, arithmetic, gardening, gas-making, gas-fitting, carpentering, painting, bricklaying, washing, needlework, dairy work, and the duties of domestic servants generally. A certain number are tanght to play on brass instruments. The pupils were exereised in drill and gymnastics, einging and instrumental music.

The Post-Office in 1868.—The number of letters delivered in the United Kingdom in 1868 was in round nnmbers 808,118,000, an increase of 4·29 per cent. over the nnmber in 1867. Tbis gives an average of 26 letters to each person, 149 to each bouse—in England 30 letters to each person; in Scotland 24; in Ireland 10. The nnmber of book packets, newspapers, and pattern packets delivered by post in the United Kingdom in 1868 advanced to 105,845,000, an increase of 3·49 per cent. over the nnmber in the previous year. The depositors in Post Office Savings Banks at the end of the year 1868 were 965,154, an increase of 12·8 per cent. over the preceding year—13·3 per cent. in England, 3·6 per cent. in Scotland, 8·7 per cent. in Ireland. The balance due to depositors, £11,666,655, showed an increase of 19·6 per cent.—19·2 per cent. in England, 19·2 per cent. in Scotland, 33 per cent. in Ireland. The total nnmber of depositors in Post Office Savings Banks and the Old Savinge Banks, 2,336,654, or one to every 13 persons, ehowed an increase of 97,307. The number of policies effected with the Government through the Post Office increased from 1,485 at the close of 1867, to 1,789 at the close of 1868; the amonnt insured from £111,437 to £134, 824. Tbe number of immediate annuities from 551 to 874; the amount from £12,393 a year to £18,789. The nnmber of deferred annuities from 137 to 160, and the amount from £2,574 to £2,971 On the other hand, the amount for which money-orders were issued fell from £19,282,109 in 1867 to £19,079, 162 in 1868, a decrease of ahont 1 per cent., due to the distribution of the Parliamentary grant for education hy the Privy Council Office being no longer made by means of money-orders. Only £115,827 of this grant was thus distributed in 1868, as against £502,960 in 1867. In 1868 516 additional receptacles for letters were opened in the United Kingdom—463 in England, 21 in Scotland, and 32 in Ireland—raising the total nnmber in England from 13,592, as it stood at the close of 1867, to 14,055, or one to every 288 inhabited houses; in Scotland from 1,618 to 1,639, or one to every 250 inhabited houses; in Ireland from 2,015 to 2,047, or one to every 464 inhabited houses; and in tbe United Kingdom from 17,225 to 17,741, or one to every 305 inhabited houses. Of these letters, no less than 13,833 were posted without any address at all, and of these 13,833 letters 281 were found to contain money to the amount of £6,375.

Prussian Coals.—The following is an extract from the *North German Correspondent* newspaper, containing informntion taken from an official source :—The consumption of English coals in Berlin and the Prussian inland provinces has for some years past shown a gradual diminution, owing to the increasing use of Silesian and Saxon (Zwickau) coals. Notwithstanding this the whole importation of English coals into the Zollverein from 1857 to 1867 shows an augmentation of 4,418,300 centners, or 22 per cent., an increase entirely owing to the very large consumption of these coals in the maritime provinces of Prussia,which can procure them cheaper by sea from England than from the interior or from Saxony hy land carriage. In the ports of the North German Confederation English coals are yearly becoming more important as an article of commerce. In 1867 Lübeck imported 22,299 tons; Memel, 35,319; and Neufahrwasser, 16,840; or, together, 74,458 tons of English coals; and there is not a single Baltic port in which their purchase and sale do not give rise to large transactions every year. The *Staats Anzeiger* collates the quantities of coal raised in England and Prussia respectively during the years 1867 and 1868. In Great Britain, in the former year, 3,195 coalpits, with 333,116 workmen, produced 105,078,000 tons, or 2,133,083,000 zollcentners. In 1868 the production had fallen to 104½ millions of tons, or 2,121 millions zollcentners, while the number of pits had risen to 3,291, and that of the miners to 346,820. In Prussia, during the year 1867, 426 pits, with 102,773 workmen, produced 420,571,116 centners of coals, and in 1868, with 106,348 men, they yielded 454,486,660 centners. While the coal production of Great Britain in the year 1854 was ten times greater than that of Prussia, being 64,661,000 tons, or 1,312,618,300 centners, against 136,225,096 centners, in 1867, it was only five times as great, and in 1868 only 4·6 times. Leaving out of account the recent territorial acquisitions of Prussia, we find the production of coals in the old provinces amounted in 1868 to 4·7 of that of Great Britain. While the amount of coals raised in the latter country from 1854 to 1868 increased hy forty millions of tons (812 millions of centners) or 62 per cent., it rose in the old Prussian provinces to no less than 310,379,729 centners, or 200 per cent. The average yield of a coalpit in Great Britain in 1867 was 667,000 centners, and 644,000 centners in 1868; in Prussia it was 987,000 centners in 1867, and 1,067,000 centners in 1868. On the other hand, the average quantity raised by each miner in the two years was 6,398 and 6,116 centners in Great Britain, and 4,092 and 4,273 centners, or 43 per cent. less in Prussia. The proportion of accidental deaths of miners in 1867 was 1 in 280, and for every 1,792,499 centners of coals produced in Great Britain. In Prussia one man in 352·5 and for every 1,440,157 centners raised. Of the entire accidents in British mines in 1867, 24·3 per cent. were caused by explosions, against 13·31 in Prussian pits; 37·73 per cent., against 36·13 in Prussia, hy earth-slips ; 17·73 per cent. against 25·26 in Prussia, hy other accidents underground ; 7·40 per cent., against 3·7, hy accidents above ground; and 13·11 per cent. against 22·18, hy accidents in the shafts.

## APPLICATIONS FOR
# PROVISIONAL PROTECTION FOR INVENTIONS
## UNDER THE PATENT LAW AMENDMENT ACT.

☞ When the city or town is not mentioned, London is to he understood.

*26th August* 1869.

2533 C. D. Abel, Southampton Buildings—Separating or dividing the carded fleece into slivers in carding machines for all kinds of filaments.—A com.
2534 H. P. Stephenson, Abingdon Street, E. G. Bartholomew, Upper Holloway, and R. King, Saint Mary Axe—Lighting and extinguishing gas lamps
2535 B. Hunt, Serle Street, Lincoln's Inn—Improvements in steam condensers, and in supplying steam generators with water.—A com.
2536 H. Yates, St. Pierre les Calais, France—Manufacture of lace on bobbin net or twist lace machinery
2537 W. R. Lake, Southampton Buildings—Machinery for carding and spinning fibrous materials.—A com.

*27th August* 1869.

2538 E. A. Cowper, Great Gcorge Street—Treating cast iron for the production of wrought iron and steel therefrom
2539 A. Moncrieff, Culfargie, Perth—Improvements in the means and apparatus for absorbing, storing, and utilizing the force of recoil of ordnance, and in applying and working covers, roofs, or shields to gun platforms
2540 J. M. Stanley, Sheffield—Manufacture of iron and steel
2541 O. Vivier, Sekforde Street, Clerkenwell—Apparatus for measuring and indicating the distance travelled by vehicles
2542 F. J. Drechsler, Cockspur Street—Stovcs and grates or apparatus for cooking, heating &c.
2543 W. E. Gedge, Wellington Street, Strand—Railway sleeper.—A com.
2544 B. Hunt, Serle Street, Lincoln's Inn—Apparatus for hulling, cleansing, and polishiug or preparing coffee, rice &c.—A com.
2545 J. Teychenné, Small Heath, near Birmingham—Springs for mattresses, sofas, chairs, and other articles of furniture
2546 E. A. Campbell, Rugby—Extraction of essence of roasted coffee
2547 W. R. Lake, Southampton Buildings—Apparatus for rendering and refining lard, tallow &c.—A com.
2548 J. Fion and W. Charlet, Brussels—Sash or frame work for landau and landaulet carriage doors
2549 S. C. Lister, Bradford—Looms
2550 R. C. Rapier, Westminster Chambers—Railway water cranes
2551 J. Ritchie, Barnsbury—Tents and sunshades or weather protectors suitable for carriages

*28th August* 1869.

2552 C. Duff, Russell Street, Bermondsey—Manufacture of paper pulp and paper
2553 T. S. Blair, Pittsburg, Pennsylvania, U.S., and F. Ellershausen, Ellershouse, Nova Scotia—Treating conglomerates of cast iron and other substances
2554 J. Butterworth and J. Ainsworth, Bury, Lancaster—Mangling and squeezing machines
2555 J. Spencer and J. Consterdine, Hollingwood, near Manchester—Portable drilling machinery
2556 J. Holdsworth, Kingston-upon-Hull—Apparatus for loading or discharging grain, coals, ballast &c.
2557 R. H. Herriott, Skegby, Nottingham, C. Plumbe, Mansfield, Nottingham, and W. A. Plumbe, Sutton in Ashfield, Nottingham—Communicating between passengers and the guard and driver of railway trains
2558 J. Brown, Padiham, Lancaster—Facilitating the exercise or riding of bicycles or velocipedes
2559 C. S. W. Muir, Kilmarnock, N.B.—Steam boilers &c.
2560 R. C. Robinson, Preston—Fire-grate
2561 J. Loader, Upper Clifton Street, Worship Square—Rotary engines and pumps
2562 R. Priestley, London Wall—Fastenings for gloves

*30th August* 1869.

2563 L. Goldberg, Love Lane—Watches, toy-watches, personal ornaments, purses, pocket-books, walking-sticks &c.
2564 R. J. Westley, Camden Road—Constructing, converting, and using billiard and other tables
2565 W. Young, Londonderry—Clarifying and refining butter &c.
2566 T. Cattell, Strand—Treating wood for the production of paper-pulp
2567 W. F. Williams, Broad Street, Golden Square—Boxes for holding jewellery &c.
2568 W. Winter, Leeds—Metallic driving belt or band
2569 W. E. Newton, Chancery Lane—Machinery for manufacturing nails, brads &c.—A com.
2570 H. E. Newton, Chancery Lane—Furnaces.—A com.
2571 C. R. Stooke, Teignmouth—Safety cages for mine shafts

*31st August* 1869.

2572 F. W. Potter, Barbican—Wire-work applicable for sieves, screens &c.
2573 F. Dnrand and C. Beslay, Paris—Applying the incompressibility of liquids for imparting the required stiffness to suitable supple bodies for allowing them to be made use of as armatures for building tunnels or other submarine constructions &c.
2574 A. P. Tronchon, Paris—Construction of elastic seats
2575 A. McNeile, John Street, Pentonville—Brakes for retarding the progress of wheeled carriages
2576 W. Glover, Prestwich—Looms
2577 W. E. Newton, Chancery Lane—Washing machines.—A com.
2578 T. Coles, Woolwich—Running wheels of carriages and other vehicles mounted on wheels, and wheels and riggers used in machinery
2579 T. Wardlaw, Dunfermline, N.B.—Reaping machines

*1st September* 1869.

2580 T. Wilson, Birmingham—Screw and ratchet wrenches
2581 J. Grice and J. G. Harrison, Birmingham—Axles for carriages
2582 J. Shand, Upper Ground Street, Blackfriars—Direct-acting steam pumping engines and steam fire-engines
2583 S. Schiff, Great Alie Street, Goodman's Fields—Charging pipes for smoking tobacco
2584 W. S. Laycock, Sheffield—Weaving certain kinds of fabrics
2585 G. H. Nussey and W. B. Leachman, Leeds—Apparatus for pressing woollen and other woven or felted fabrics
2586 T. Greenwood and J. Bapty, Leeds—Machinery for combing silk and other fibrous materials
2587 B. Isangk, Rouen, France—Apparatus for indicating and registering the pressure of steam or other gases or liquids
2588 R. Scott and W. Mac Ivor, Addiewell, Midlothian—Treatment of hydrocarbon oils
2589 A. M. Davis, Bromley, Kent—Aërated alcoholic drinks

*2nd September* 1869.

2590 S. Willis, Swannington, Leicester—Railway chairs.—A com.
2591 R. Pitcairn, Trafalgar Sqnare—Rest for supporting the arms, feet, or body of a person, or books &c.
2592 J. Day, Manchester—Raising or closing the glasses or shntters of carriage doors and windows
2593 P. McGough, Halifax—Sasb frames and sashes
2594 F. Prestage, Gresham Street—Apparatus to be adapted to railroad carriages for the purpose of assisting in retarding tbeir progress when desired

*3rd September* 1869.

2595 E. D. Temple, Finsbury Circus—Telegrapb railway signal, scaffold, and otber posts
2596 S. H. Greaves, Sheffield—Manufacture of knives and forks, spear points, daggers &c.
2597 T. Slater, Enston Road—Construction of electro-magnetic machines as motors &c.
2598 A. M. Clark, Chancery Lane—Steam boilers.—A com.
2599 H. Bridgewater, Watford—Improvements in railway chairs and in the means of securing bridge and flanged rails to their sleepers
2600 R. Spear, New Haven, Connecticnt, U.S.—Transmitting power for operating marine signals and for other purposes by means of air or fluid
2601 A. Ogg, Kynaston Street, Lambeth—Printing machines
2602 W. H. Burnett, Great Coram Street—Improved modes of signalling on railways by means of sound
2603 G. Henley, Essex Street, Islington—Dial or needle and alphabetical telegraphs and relays

*4th September* 1869.

2604 J. G. Lynde, Manchester—A diaphragm indicator
2605 J. Webster, Birmingham—Nozzle for blowing air, steam, water, or other liquids and gases
2606 H. Defries, Honndsditeh—Application of glass to decorative or ornamental purposes
2607 J. Jnckes, Wigan, and E. Wood, Bolton—Furnaces
2608 P. Spence, Manchester—Separation of copper from ores
2609 W. Ambler and B. Jowett, Bradford—Advertising
2610 J. Hargreaves, Preston—Extracting phosphoric acid and phosphorus from the tap einder of pnddling furnaces and iron refineries &c.
2611 W. H. Reade, Great Sutton Street, Clerkenwell—Machinery for clipping and cleansing the hair of animals
2612 J. Porteous, Edinburgh, and H. Gibson, Musselburgh, N.B.—Manufacture of tobacco
2613 W. Wright, Mostyn, Flint—Treatment of burnt cnpreous pyrites for the extraction of the metals contained therein
2614 F. H. W. Heuer, South Place, Finsbury—Velocipedes.—A com.
2615 W. S. Clark, Street, Somerset—Manufacture of boots and shoes

*6th September* 1869.

2616 C. F. Claus, Middlesborongh-on-Tees—Mannfacture of carbonate of soda
2617 T. S. Webb, near Stockton-on-Tees—Manufacture of iron and steel
2618 J. Edwards, Hackney—Railway carriages
2619 C. D. Escoffier, Paris—Construction of castors or rollers for furniture.—A com.
2620 E. T. Hnghes, Chancery Lane—Construction of doors.—A com.
2621 T. H. Blamires, Huddersfield—Rubbers for condensers and piecing machines
2622 W. E. Newton, Chancery Lane—Reaping and mowing machines.—A com.
2623 F. Wicke, Bockenheim, Prussia, J. Bronner, T. Petersen and J. Gzehfuss, Frankfort-on-the-Maine—Treatment of human excrements, whereby they are converted into an inodorous, dry, and easily portable manure
2624 W. E. Gedge, Wellington Street, Strand—Apparatus for rectifying alcohols.—A com.
2625 S. F. and A. B. Ibbotson, Sheffield—Joints for uniting and securing the ends of railway rails
2626 W. R. Lake, Sonthampton Buildings—Velocipedes.—A com.

*7th September* 1869.

2627 R. Martyn, Redruth, W. W. Martyn, Pennance Gwennap, W. C. Trevenua, Redruth, and T. H. Harry, Redruth—A wheel bnddle for dressing tin ores, and ores of all metals and water, with ore in suspension and earthy substances
2628 W. B. Thompson, Dundee, N.B.—Auxiliary screw propellers
2629 W. H. Richards, Birmingham—Chair and trunk nails
2630 S. Rawsthorne and J. Metcalf, Preston—Mules for spinning
2631 A. M. Clark, Chancery Lane—Construction of ships and other vessels.—A com.
2632 F. Ellershansen, Ellershouse, Nova Scotia—Utilizing the force of the waves
2633 T. King, West Farm, New York, U.S.—Pianofortes
2634 G. Little, Rutherfurd Park, New Jersey, U.S.—Apparatus for composing, transmitting, and receiving telegraphie eommunications
2635 A. V. Newton, Chancery Lane—Preventing tbe radiation of heat from steam boilers. A com.

*8th September* 1869.

2636 R. E. Hodges, Southampton Row—Keyhole guides
2637 R. H. Hill, Parliament Street—Crossings for railways
2638 H. D. P. Cunningham, Bury, near Gosport—Lifting up and taking off heavy bodies on and from racks or stands or carriages
2639 H. B. Barlow, Manchester—Knitting machine.—A com.
2640 S. Oddy, Salford, and R. Nnttall, Bury—Mules for spinning.—Partly a com.
2641 C. P. Stewart and J. Kershaw, Manchester—Centre rail locomotives
2642 K. Krans, Sidmonth Street—Watcb protector
2643 T. Walker, Robert Street, Chelsea—Electro-telegraphy
2644 C. H. Murray, Loman Street, Southwark—Screw propellers
2645 W. E. Newton, Chancery Lane—Metallie packing for piston rods.—A com.
2646 A. M. Clark, Chancery Lane—Machine for entting or dressing millstones.—A com.
2647 A. Earnshaw and G. E. Earnshaw, Sheffield, and F. Earnshaw, Harrington Street, Middlesex—Apparatus for comparing musical keys, and for examining and explaining mnsical relations and harmonies, chords, and consonances
2648 J. A. Mnller, Amsterdam—Apparatus for measuring and registering the flow of water and other liquids
2649 W. Baines, Smetbwick—Apparatus for ensuring safety to railway trains

*9th September* 1869.

2650 W. Palliser, Army and Navy Club, Pall Mall—Rails for railways
2651 D. J. Williams, Birmingham—Improvements in movable partitions for tbe interior of buildings, and in shntters for snch wide openings in the outside walls of buildings as require no glass or like substance
2652 F. Forder and J. J. Traves, Wolverhampton—Bearings of loose axles for velocipedes and other carriages
2653 J. Gillies, Glasgow, N.B.—Bushes or shields for the bnngholes of casks or other vessels
2654 A. H. Gilmore, Edinburgh—Protecting or shielding wounds, cutaneous injuries, and sores
2655 H. A. Bonneville, Sackville Street, Piccadilly—Electric batteries.—A com.
2656 W. T. Lillicrap, Stonehouse, Devon—Carts and other vehicles
2657 J. A. Jaques, Tottenham, Middlesex, J. T. Oakley, Grange Road, Bermondsey, and J. A. Fanshawe, Tottenham, Middlesex—Machinery for grinding and surfacing rings, plates, discs &c.
2658 D. Colville, Red Lion Court, Fleet Street—Producing printing surfaces

*10th September* 1869.

2659 A. H. Brandon, Paris—Central-fire cartridges for breecb-loading firearms.—A com.
2660 P. Hall, Birkenhead—Apparatus for transmitting motive power
2661 W. Morris, Whitechapel—Manufacture of cigars.—A com.
2662 W. N. Nicholson, Newark-upon-Trent, and G. Black, Grantham—Agricultural drills for sowing grain and seeds
2663 J. H. Johnson, Lincoln's Inn Fields—Fastening for metallic hoops or bands.—A com.

*11th September* 1869.

2664 W. R. Lake, Southampton Buildings—Apparatus for extinguishing fires.—A com.
2665 L. Henrion, San Pier d'Arena, Italy—Promoting combustion in fire-places and furnaces
2666 S. Simpson, Preston—Machinery for drawing fine wire
2667 B. Kershaw, Warwick Place, Maida Hill—Vessels or apparatus for preserving meat &c.
2668 J. E. Moorhead and W. Dudgeon, Donacloney, Ireland—Jacquard machines
2669 J. H. Johnson, Lincoln's Inn Fields—Apparatus for prodncing sonorous signals and musical sounds.—A com.
2670 J. G. Tongue, Southampton Buildings—Machinery or apparatus for moulding articles in ceramic or plastic materials.—A com.
2671 W. A. Lyttle, The Grove, Hammersmith—Telegraph posts
2672 M. Andrew, Melbourne, Victoria—Locks and latches
2673 J. Betteley, Bootle—Constructing and sheathing ships
2674 S. Fox, Deepcar, near Sheffield—Permanent way of railways
2675 J. B. Palmer, Old Ford Road, Bow—Improvements in manufacture of matebes and fusees and of surfaces to be used for igniting matches and fusees

*13th September* 1869.

2676 F. S. Cocker, Kingsland—Velocipedes
2677 W. E. Gedge, Wellington Street, Strand—Preventing liquids in ebullition from boiling over.—A com.
2678 A. V. Newton, Chancery Lane—Extinguisbing fires and watering streets.—A com.
2679 C. Burke, Bandon, Cork, Ireland—Treatment of fatty and oily matters to prepare them for the manufacture of candles &c.

*14th September* 1869.

2680 R. Lakin, Manchester, and J. Bayley, Heaton Norris—Machinery for preparing, spinning, twisting, and doubling cotton
2681 C. D. Abel, Southampton Buildings—Apparatus for preventiug accidents through the closing of doors and windows.—A com.
2682 W. E. Gedge, Wellington Street, Strand—Vehicle for locomotion by land and water. A com.
2683 M. Grouse, Southampton Row—Envelopes
2684 J. J. Bodmer, Newport, Monmouth—Manufacture of iron and steel
2685 W. E. Newton, Chancery Lane—Pumps.—A com.
2686 W. E. Newton, Chancery Lane—Furnaces and ovens or kilns.—A com.
2687 C. C. Steenstrup, New Broad Street—Breech-loading and other ordnance
2688 A. H. Gilmore, Edinburgh—Safety lamps

*15th September* 1869.

2689 J. Holding and J. Eccles, Manchester—Looms
2690 H. Allman, Gower Street—Ships' compasses
2691 P. M. Fouque, Paris—Holder for cartridges
2692 T. Restell, Birmingham—Breech-loading firearms
2693 G. Shaw, Birmingham—Combined buckle and button-hole.—A com.
2694 G. Shaw, Birmingham—Stoves and furnaces for burning solid fuel.—A com.
2695 W. E. Gedge, Wellington Street, Strand—Geographical game.—A com.
2696 C. G. Hill, Nottingham—Manufacture of ruches and other trimmings
2697 W. E. Newton, Chancery Lane—Machinery for the manufacture of felt and other cloths.—A com.
2698 A. V. Newton, Chancery Lane—Steam and caloric engines.—A com.
2699 C. Mohr and S. E. Smith, Birmingham—Cages for birds, squirrels &c.
2700 A. M. Clark, Chancery Lane—Key guards.—A com.

*16th September* 1869.

2701 H. B. Barlow, Manchester—Apparatus for preventing the inerustation and the accumulation of sediment in steam boilers.—A com.
2702 W. Bettison, Liverpool—Potters' glaze and seggar wash
2703 W. Tipping, Wigan—Apparatus for preventing or consuming smoke
2704 J. Hampson, Bradford—Apparatus used in the manufacture of pipes from lead &c.
2705 J. H. Johnson, Lincoln's Inn Fields—Correcting the deviations of the mariuer's compass and dipping needle.—A com.
2706 C. Eskrett and H. Searle, Kingston-upon-Hull—"Envelopes" or "hairs" nsed in extracting oil from oleaginous seeds, and oil making
2707 G. A. C. Bremice, Liverpool—Machinery for breakiug and softening flax, &c.

*17th September* 1869.

2708 J. Sawyer, Alma Street, New North Road—Furnaces for steam boilers
2709 R. Stone, Liverpool—Floors and roofs
2710 C. M. Waddie, Edinburgh, N.B.—Printing press
2711 O. H. J. Krag, New Broad Street—Firearms
2712 A. Collingridge, Moorgate Street—Stowing and laying submarine telegraph cables

*18th September* 1869.

2713 T. and W. Wheatley, Glasgow, N.B.—Fastenings for carriage doors
2714 R. S. Burkitt, Manchester—Apparatus for effecting the combustion of smoke in furnaces or fire-places
2715 J. Belicard, Manchester—Looms
2716 H. W. Harman and W. Lancaster, Manchester—Steam boilers
2717 M. Amberg, Seacombe, near Liverpool—Instrument for obtaining samples from bales of cotton-wool &c.
2718 T. J. Denne, Cambridge Road, Mile End, and H. Billingsley, Brandon Road, Victoria Park—Producing transfers and blocks for lithographic and other printing
2719 N. J. Dor, Ampsin, Liége, Belgium—Manufacturing crucibles, muffles, gas-retorts &c. through the agency of hydraulic presses
2720 C. Belier, Aldermanbury—Manufacturing binding tapes.—A com.
2721 A. Lacanau, Grasse, France—Thermo-electric alarum
2722 H. A. Bonneville, Paris—Utilising the waste arising in spinning vegetable fibrous materials.—A com.
2723 H. J. Rogers, Chancery Lane—Weighing scales.—A com.
2724 J. G. Willans, Paddington—Manufacture of iron and steel
2725 W. R. Lake, Southampton Buildings—Galvanising metals.—A com.
2726 J. L. Norton, Belle Sauvage Yard—Looms
2727 C. Winn, Birmingham—Machinery for cutting or shaping metals

*20th September* 1869.

2728 S. A. Varley, Roman Road, Holloway—Electrie telegraphs
2729 J. N. Steiner, Paris—Velocipedes
2730 J. Polson, Paisley, N.B.—Treating grain
2731 A. Tylor, Newgate Street—In water taps and cistern apparatus
2732 W. E. Gedge, Wellington Street, Strand—Press bed.—A com.

2733 M. Doirier, Periguenx, Dordogne, France—Velocimanes
2734 P. Wisdom, Brooklyn, New York, U.S.—Machine for twisting and curling hair for use in stuffing beds, furniture &c.
2735 W. A. Gilbee, South Street, Finsbury—Apparatus for heating wines &c.—A com.
2736 C. E. Brooman, Fleet Street—Manufactnre of chains.—A com.
2737 W. E. Newton, Chancery Lane—Machinery for the manufacture of tape trimmings.—A com.
2378 C. E. Schoeller, South Hackney—Copying presses

*21st September* 1869.

2739 H. and F. C. Cockey, Frome Selwood—Apparatus for scurfing retorts
2740 J. Elce, Manchester—Bobbins or spools &c.
2741 R. Swift, Hounslow—Iron kegs &c.
2742 J. l'Anson, jun., Darlington—Locking apparatus for controlling railway switches and signals
2743 P. J. Kurtz, Rippberg, near Walldürn, Baden—Chaff cutters
2744 J. Jacobi, Kladno, Bohemia—Removing phosphate from ores &c.
2745 W. R. Lake, Southampton Buildings—Spindles and fliers of spinning frames.—A com.
2746 A. V. Newton, Chancery Lane—Treatment of spirits or alcoholic liquids for the purification of the same &c.—A com.
2747 R. L. Hickes, Liverpool Street—Cartridges

*22nd September* 1869.

2748 M. Macleod, Manchester—Apparatus for sanitary purposes
2749 J. Windsor, Braddan, Isle of Man—Desiccating and preserving potatoes
2750 G. H. Chatwin, Gresham Street—Umbrellas, parasols &c.
2751 E. Hill, Longton, Stafford—Slide valves
2752 R. R. Gibbs, Liverpool—Pumps, vacuum pumps, and blast engines &c.
2753 W. J. Cunningham, New Oxford Street, and A. P. McCarthy, Bloomsbury—Obtaining motive power
2754 J. Tarbuck and T. Burns, Abram, near Wigan, Lancaster—Pumping water from shafts, pits &c.
2755 C. L. Light, Richmond, Surrey—Improvements in the construction of tram-rails, in the modes of fastening the same, and in a mode of shifting carriages from one line of rails to another
2756 W. R. Lake, Southampton Buildings—Purifying solutions of sugar and syrups.—A com.
2757 W. R. Lake, Southampton Buildings—Sewing machine and other needles.—A com.
2758 A. V. Newton, Chancery Lane—Threshing machines.—A com.
2759 H. R. Minns, Bristol—Mechanism for locking or securely connecting the doors of safes, strong rooms &c.
2760 E. Hernulewicz, King William Street—Securing the intermediate uprights of all kinds of metal and wood fencing

*23rd September* 1869.

2761 W. Black and T. Hawthorn, Gateshead-on-Tyne—Locomotive engines and vehicles intended to run on railways and tramways
2762 D. Witty, Manchester—Apparatus for propelling vessels
2763 R. C. Wallace and D. Crawford, Ardrossan, N.B.—Pumps
2764 J. Watson, Govan, N.B.—Tyres for wheels
2765 V. Chemery, Sedan, France—Apparatus for damping and pressing simultaneously the surface of cloth and felted fabrics previous to finishing
2766 J. F. R. Badiou and F. Bernard, Paris—Shoes for horses, mules &c.
2767 W. E. Gedge, Wellington Street, Strand—Drying machine.—A com.
2768 W. J. Turner and H. Yewdall, Bradford—Apparatus for the manufacture of bisulphites &c.
2769 F. Trench, Dublin, and E. C. Warner, Brighton—Horseshoes
2770 G. A. C. Bremme, Liverpool—Machinery for untwisting and unlaying threads, yarns, strands, ropes &c.
2771 J. M. and J. B. Spence, Manchester—Manufacture of disinfectants
2772 W. E. Newton, Chancery Lane—Apparatus for drying grain &c.—A com.
2773 J. Mackenzie, Edinburgh, N.B.—Weighing machines
2774 J. B. Spence, Manchester—Feeding steam boiler and other furnaces with fuel

*24th September* 1869.

2775 J. Faulkner, Manchester—Exhausting, drawing, or draining the gas from coal and coal mines
2776 W. H. Hewett, Great Yarmouth—Producing characters, inscriptions, devices, and designs on metal surfaces
2777 B. Hunt, Serle Street, Lincoln's Inn—Automatic railway carriage or car brake.—A com.
2778 W. Strang, Glasgow, N.B.—Apparatus for dressing and beaming warps
2779 R. Collis, Webber Street, Blackfriars Road—Propelling velocipedes
2780 J. H. Davis, Notting Hill—Ships' compasses
2781 W. I. Palmer, Reading—Manufacture of paper
2782 G. L. Morton, Camberwell—Stoppering bottles
2783 J. T. Greenfield, Dover—Side-arm for clearing the chambers and rifling of ordnance
2784 J. W. Morgan, Liverpool—Ships' and mooring anchors
2785 T. B. Daft, Brixton, E. Axmann, Hampstead, and T. W. Willin, Clerkenwell Green—Watches and other time-keepers

*25th September* 1869.

2786 I. Farrell, Dublin—Bearings for axles, shafting &c.
2787 W. Harper, Bolton—Machinery or apparatus for suspending fabrics in drying stoves
2788 J. T. Gaze and J. Hymas, Erith—Fire bars
2789 H. A. Bonneville, Paris—Greek firearm.—A com.
2790 J. P. Turner, Birmingham—Buckles or fastenings for braces, belts, bands &c.—A com.
2791 J. W. More, Market Street, Finsbury, and J. Norman, Hoxton Square—Clipping horses and other animals
2792 J. Worrall, Manchester, and J. Kershaw, Wandsworth—Machinery for folding piece goods
2793 S. G. Archibald, Edinburgh, N.B.—Machinery for carding and twisting or spinning oakum, and for balling the same
2794 J. C. Cushion, Penrose Street, Walworth—Mill bills or chisels and picks for dressing millstones, marble &c.
2795 J. Stuart, Limehouse—Treatment of the ores of the metals and their products &c.
2796 G. W. Rendel, Newcastle-upon-Tyne—Gun carriages and slides
2797 G. W. Rendel, Newcastle-upon-Tyne—Breech-loading guns

*27th September* 1869.

2798 T. Hall, J. B. McKerrow, and T. R. Shaw, Pendleton—Effecting the removal or discharge of dye wood from hanks or yarn
2799 C. de Bergue, Strand—Utilising man's muscular power when employed in driving machinery
2800 W. Boulderson, Strand—Coverings for the head
2801 F. W. Fox and E. Walker, Atlas Iron Works, near Bristol—Locomotive and other engines, and their steam boilers
2802 J. Peel, J. Sharp, and J. Walworth, Bradford—Looms
2803 G. Bennie, Kinning Park, Renfrew, N.B.—Distilling oils from minerals
2804 J. Hastie, Greenock, N.B.—Improvements in applying heat and in obtaining motive power
2805 R. Harlow, Heaton Norris—Valves or cocks
2806 E. O'Brien, Liverpool—Self-feeding, discharging, and registering beam balance for weighing grain &c.
2807 G. T. Bousfield, Brixton—Manufacture of sized paper.—A com.
2808 J. R. Swann, Edinburgh—Boiler tubes
2809 J. R. Wigham, Monkstown, Dublin—Illuminating buoys, beacons, lighthouses &c.
2810 T. R. and T. W. Harding, Leeds—Leather driving bands
2811 W. E. Newton, Chancery Lane—Lappet or embroidering looms.—A com.
2812 W. Kendall, Newcastle-on-Tyne—Furnaces
2813 F. Armstrong, Paris—Knitting machines.—A com.

*28th September* 1869.

2814 W. Chambers, United University Club, Suffolk Street—Ventilating
2815 J. Taylor, Sheffield—Brad awls
2816 W. Whiteley, Lockwood, near Huddersfield—Apparatus for roving and spinning wool, cotton &c.
2817 R. and H. Harrild, Farringdon Street—Composition for the manufacture of printing rollers
2818 C. D. Abel, Southampton Buildings—Green colouring matter.—A com.
2819 J. Buchanan, Hebburn, Durham—Substitute for "soda crystals," "soda ash," or "refined ash"
2820 J. Bullough, Accrington—Looms.—A com.
2821 H. Swan, Hammersmith—Millstones
2822 J. W. Billiatt, Grantham—Elevators
2823 H. Y. D. Scott, Ealing—Pottery, lime, and other kilns
2824 A. V. Newton, Chancery Lane—Manufacture of horse-shoe nails.—A com.
2825 W. R. Lake, Southampton Buildings—Apparatus for preventing alteration of valnes in monetary instruments.—A com.
2826 W. R. Lake, Southampton Buildings—Harvesting machines.—A com.

*29th September* 1869.

2827 W. H. Noble, Plumstead—Aërial carriage.—A com.
2828 A. J. Dulake, Redhill—Pot or vessel for containing and conveying butter, lard, jellies &c.
2829 J. Williams, Birmingham—Lifting jacks
2830 W. Walker and D. Davies, Manchester—Furnaces
2831 W. Blunn and J. Wild, Kilnhurst, near Rotherham—Furnace cistern for melting material from which glass is made &c.
2832 D. Duthie, Edinburgh, N.B.—Machine for tenoning timber
2833 L. Wray, Ramsgate—Apparatus for crushing stone
2834 W. and A. Kempe, Leeds—Screys or tables, applicable to gig mills, brushing mills & c.
2835 H. Hughes, Homerton—Rolling or reducing metal rods, bars, or tubes

*30th September* 1869.

2836 A. F. Wilson, Parà, Brazil—Utilizing waste heat from the furnaces of gas retorts
2837 J. Anderson, Glasgow, N.B.—Treating and separating the constituents of maize, and obtaining oil, starch, spirit &c.
2838 J. P. Kerr and W. McGee, Paisley, N.B.—Winding thread or yarn upon pirns
2839 H. Woolf, Houndsditch—Hat brims
2840 W. Horton, Smethwick—Steam boilers
2841 J. Reeves, Sparkbrook, Worcester—Bearings of the wheels of velocipedes
2842 A. E. Fridlander, Coventry—Improvements in watches and chronometers
2843 J. Lund, Malsis Hall, near Kildwick, York, and E. Townend, Cononley, near Kildwick—Apparatus applicable to carriages, carts, wagons, and other common road vehicles, whether with four or two wheels, for adjusting the load in ascending or descending
2844 A. Gaine, Birmingham—Knobs and furniture for doors, drawers &c.
2845 G. Hinton, Ancaster, Wentworth, Canada—Driving water-power machinery
2846 J. Dewe, Toronto, York, in the province of Ontario, Canada—Locks

*1st October* 1869.

2847 H. L. Bolger, Brixton, and J. Meekin, Dulwich—Apparatus for splitting rocks &c.
2848 R. Crickmer, Doris Street—Apparatus for preventing priming in steam boilers and for regulating the supply of steam therefrom
2849 F. S. Barff, M.A., North Audley Street—Absorbing and utilizing the noxious vapours and gases arising from locomotive engine and other furnaces
2850 J. Bonn and J. Nitsch, New North Road—Instrument to be used for ruling lines on paper &c.
2851 J. H. Johnson, Lincoln's Inn Fields—Screws.—A com.
2852 E. A. A. Hugo, Aubervilliers, near Paris—Manufacture of pressed leather
2853 R. L. Hickes, Liverpool Street, Old Broad Street—Breech-loading firearms
2854 G. A. Huddart, Brynkir, Carnarvon—Joining or fishing the rails of railways
2855 W. E. Newton, Chancery Lane—Sewing machines.—A com.
2856 A. J. Eli, Euston Road, and H. Sawahn, Camden Town—Apparatus for indicating and registering the distances travelled by vehicles

*2nd October* 1869.

2857 G. S. Whitechurch and H. Whitechurch, Serle Street, Lincoln's Inn Fields—Stoves and fire-places
2858 J. Butcher, Southport—Fountain pens and pen holders
2859 A. Bodart, Huye, Belgium—Balance for ascertaining the specific gravity of liquids
2860 W. Edmondson, Manchester—Machinery for etching or engraving cylinders used for printing and embossing
2861 T. Buck and G. Messenger, St. Pancras—Pen holder or reservoir writing instrument
2862 E. Lndlow, Birmingham—Sporting cartridges for breech-loading firearms
2863 A. Keen, Edgbaston—Buckle or tie for fastening hoops or bands of metal around bales of cotton.—A com.
2864 C. A. Mangin, Paris—Apparatus used in silvering looking-glasses of all sizes
2865 E. D. Farcot, Paris—Propelling and constructing ships and boats &c.
2866 R. Broadbent, Birmingham—Gas governors
2867 A. Heathorn, Lincoln—Preparation of yeast or barm
2868 J. Reid, Glasgow, N.B.—Waterproof coats and leggings
2869 B. F. Stevens, Henrietta Street—Covering, lighting, and ventilating areas, vaults &c.—A com.

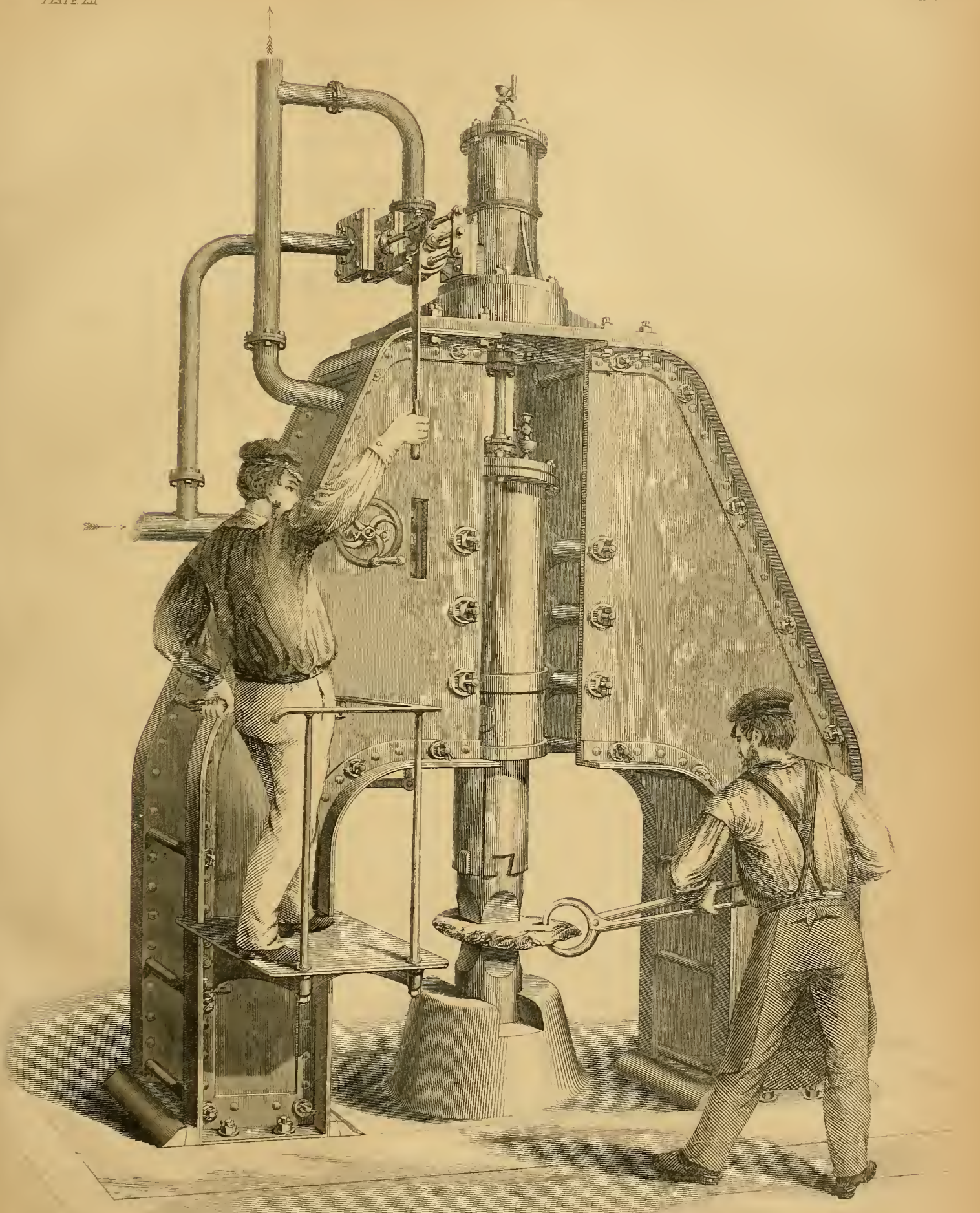
*4th October* 1869.

2870 P. R. Hodge, Adam Street, Adelphi, C. Hengst, Fulham Road, Chelsea, and N. Wilson, High Holborn—Improvements in the manufacture and cementation or welding of steel and iron, iron and iron, and steel and steel together
2871 J. A. Hartmann, Mulhouse, France—Engraving on metals
2872 F. Grâu, Paris—Lamp sockets having a double air current for burning paraffin, petroleum, and other mineral oils
2873 J. Critchley, Manchester—Umbrellas, parasols, and sunshades
2874 G. Rose, Birmingham—Annealing pots or pans and muffles
2875 Sir C. T. Bright, Westminster Chambers—Electric telegraphs
2876 C. Mather and W. Rossetter, Salford—Warping or beaming machines
2877 F. R. A. Glover, Brading, Isle of Wight—Anchors
2878 F. F. Villepigue, Brewer's Lane, Saint Martin's-in-the-Fields—Piercing or boring holes in rock, mineral &c.
2879 J. B. Bradshaw, Rotherham—Coopers' hoops

# THE BUDENBURG STEAM HAMMER.

CARL MUND, OF MAGDEBURG, INVENTOR.





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## ON SOME POINTS OF PRACTICE IN IRON-FOUNDING.
No. XL.

*Air-Furnaces. (Continued.)*

Turf or peat, that miserable fuel about which so much has been written, upon which so much ability has been expended, and with such inadequate results, is a material nearly useless to the iron-founder, unless for the production of steam-power, or for heating his drying-stoves. Yet it may be remarked, in passing, that *dry* turf, however, is occasionally a convenient material to the founder when it can be had abundantly, for drying ladles and certain classes of loam work.

For the purposes of fusion, however, in the cupola, its employment is impracticable, and the only apparatus whereby it can be applied to that purpose consists in the gas-fired reverberatory. In view of what has been actually accomplished in the north of Germany in iron-making by the help of turf-gas, there can be little doubt but that reverberatories on the regenerative system, supplied with hot air and hot turf-gas, *might* be made effective instruments of fusion for cast-iron. We should, however, never think of using such where the gases of better fuel can be had; it may be simply remembered as a conceivable resource which may be fallen back upon by any unfortunate, condemned to iron-founding in some extra-coal region of the earth.

The relative values of different sorts of gas fuel produced from different solid combustibles for reverberatory use may be at once seen from the following table given by *Scheerer*, of the chemical constitution and heating effects of waste gases from the blast furnace. (*Compendium der Gasfeuerung*, 1868.)

FURNACE GASES.

| Composition | Charcoal 1 | Charcoal 2 | Coke | Mineral Coal |
|---|---|---|---|---|
| Nitrogen | 63·4 | 59·7 | 64·4 | 56·3 |
| Carbonic Oxide | 29·6 | 20·2 | 34·6 | 21·5 |
| Carbonic Acid | 5·9 | 19·4 | 0·9 | 15·2 |
| Carbureted Hydrogen—Light | 1·0 | 0·3 | 0·0 | 4·2 |
| Hydrogen | 0·1 | 0·4 | 0·1 | 1·0 |
| Carbureted Hydrogen—Heavy | 0·0 | 0·0 | 0·0 | 1·8 |
| | 100 | 100 | 100 | 100 |
| Absolute Heating Power | 0·081 | 0·060 | 0·077 | 0·162 |
| Pyrometric Heating Power | 1255° | 1075° | 1265° | 1480° |

From this we may gather the superiority for our purposes of pit coal, not only for generating gases to be employed as reverberatory furnace fuel, but its superiority, as already remarked, to all other solid fuels for such furnaces. As this table refers to waste gases from the blast-furnace, where the gaseous educts are continually varied and affected by blast-temperature, nature of feed &c., of course the figures must be, as respects our present subject, merely regarded as *relative*.

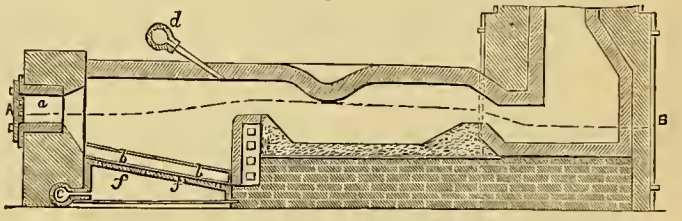
We have before said that every reverberatory is of the nature of a gas blow-pipe—with gaseous fuel it is literally so. Two systems of gas-reverberatories may, however, be distinguished: the one, that to which the Siemens furnace, as already described, belongs, in which the velocity of draught is moderate, and the heat of the interior of the furnace very uniformly diffused, so that the iron to be fused derives its heat not only from the passage of the inflamed gases but, in a large degree, from radiation from the intensely heated walls of the furnace and floor of the hearth; the second, that in which the gases and necessary supply of air, whether delivered by draught or by blast (one or both), are sent into the furnace at a high velocity, and are caused to *impinge* directly upon the mass of cast-iron to be fuzed: the main effect being here very strictly a blow-pipe one, and radiation from the interior walls &c. of the furnace but a secondary one.

In either case, with given constitution of combustible gases, the main point to attend to is, that the temperature at which both gases and air shall be delivered into the furnace, and brought into contact for ignition, shall be the highest possible: with cold air, the method may be pronounced nearly impracticable; with air at 1,000°, or upwards, it is attended with no difficulties; and where the combustible gases may be, as educts available (which is not the case in ordinary iron foundries, however large), reverberatories of this class possess the undoubted advantage of fusing the iron without any deterioration due to sulphur compounds as in solid fuel, while yet permitting nearly as wide a range of oxidizing or deoxidizing action as may be desired, or as can be obtained with reverberatories using solid fuel. From what has been just stated as to the importance of a high temperature for both air and gases, it follows, that wherever gas reverberatories may be adopted, the regenerative system should be employed also, or ovens to heat the blast, alone or in addition.

These gas-reverberatories appear best suited to iron-works where there is also a foundry on a large scale. Hot-blast and abundance of waste gases can in such cases be commanded; and where the demand for liquid foundry-iron is large and constant, probably no method of fusion—not even that by the large-sized cupola and coke fuel—will be found more economical and convenient, nor any that can yield a more liquid, clean, and beautifully flowing cast-iron to the moulder. For this, however, the plant in gas-reverberatories must be large, so that ample time may be afforded for furnace repairs, by working them in batches, and alternately. We may add, that none but the very choicest and most refractory materials should be employed for the construction and repair of these furnaces, the internal wear and tear of which, from the constancy of the heat and the reaction of the oxides, silicates &c. thereon, is far greater relatively than in any cupola. We have already (*P. M. J.*, Aug. 1869) given figures of the Siemens gas-reverberatory furnace, the type of the first class above referred to.

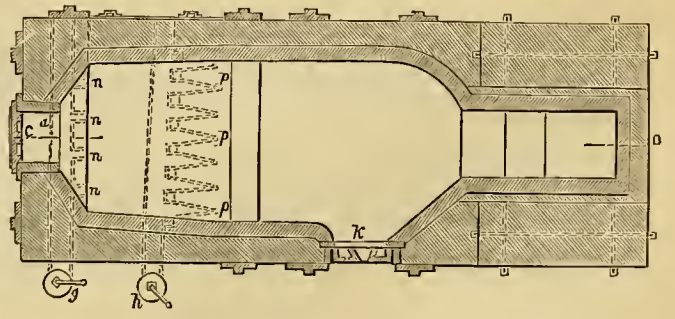
The following figures describe two different forms of the second class; they must be viewed as types only, having been designed for "balling" or puddling furnaces, but only needing certain modifications in proportions or dimensions to fit them perfectly for simple fusion of cast-iron.

Fig. 1.




In figs. 1, 2, and 3 is shown the gas-reverberatory of Herr Anthon Müller of Klagenfurt. Fig. 1 is a longitudinal section; fig. 2 a horizontal sectional plan upon the line AB; fig. 1 and fig. 3 represents the bottom side (when reversed) of the perforated air-plate *ff*. This furnace is peculiar, and stands almost *between* the two classes of gas-furnace we have formed. It contains its own

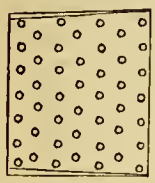
Fig. 2.




gas generator. The fuel (small or other coal here) is fed in by the door *a*, upon top of the surface above *b b*; *k* is the feeding-door for the cast-iron placed in the "pool." The furnace is supplied with two separate hot-air blast-pipes;

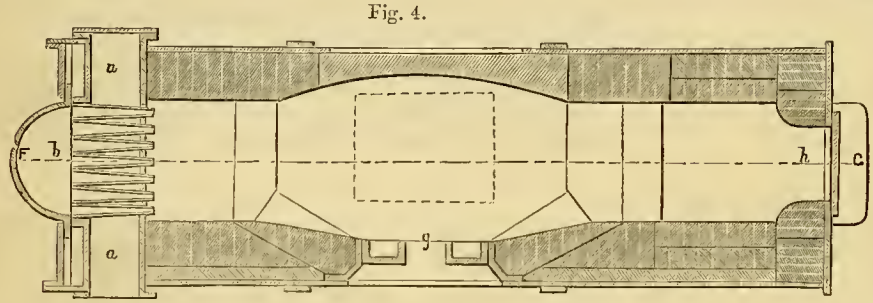
that beneath *c* delivers a certain measured proportion of hot air into the close cast-iron box beneath the fireplace, and up through the perforated top plate (fig. 3), through and over the back of the fuel in the gas-generator or fireplace, which thus, partly by a sort of sublimation, partly by slow ignition, produces the carbonic oxide &c. required to pass over the bridge. The gases are there met by hot-blast, discharged through seven twyers, inclined forward and towards the pool of the furnace, at an angle of 45° to the horizon, and supplied with measured volumes of air by the main *d*, fig. 1. In fig. 2, *p p p* show the relative positions in plan of these twyers, and *n n n n* those of the air-apertures or twyers below the plate (fig. 3). Both blasts are under regulation by the valves *g* and *h*, fig. 2, and the ashes of the fuel are continually blown away through two small apertures seen at the opposite side of the furnace in fig. 2. For puddling purposes this furnace has worked with 400 cubic feet of hot-blast per minute, at a pressure of 3 inches mercury gauge delivered by the under blast *c* (fig. 1), and 190 to 200 cubic feet per minute at half that pressure, delivered by the upper blast *d* (fig. 1) : about the same relative proportions would probably be found to answer for simple fusion. This furnace, though probably a little complicated in working arrangement, would no doubt prove under efficient control when once its proportions and regimen of work had been found by experience.

Fig. 3.



In figs. 4, 5 and 6 is shown a pure gas reverberatory melting furnace, which, as applied to puddling and worked with gas from wood and charcoal in Sweden, is stated to have been designed by Tunner. Fig. 5 is the longitudinal section, fig. 4 the horizontal sectional plan upon the line A B (fig. 5), and fig. 6 a vertical transverse section through C E (fig. 5).

Fig. 4.




The chimney for this furnace is 50 feet in height, with a minimum section of about 400 square inches. In the throat, reachable by the door *h*, is placed the cockle *d' d e*, consisting of five U pipes, connected by horizontal straight square pipes for heating the air-blast by the waste heat of the furnace. The hot blast passes by the pipe *f* to *b*, figs. 4 and 5, where, at the end of the furnace remote from the chimney-stalk, it is delivered into the interior through seven twyers under valve control. These twyers all pass through the large cast-iron trunk *a a*, by which the current of combustible gases from the gas generator are led into the furnace. These escape into the furnace through seven concentric apertures in the trunk *a a*, each around one of the air-blast twyers : *g* is the feeding-door for iron. To adapt this furnace to simple fusion, all that is needed would be to shorten the bed somewhat, and incline it towards the twyers' end, so as to make the greatest depth of the pool and the tapping-hole there.

Fig. 5.

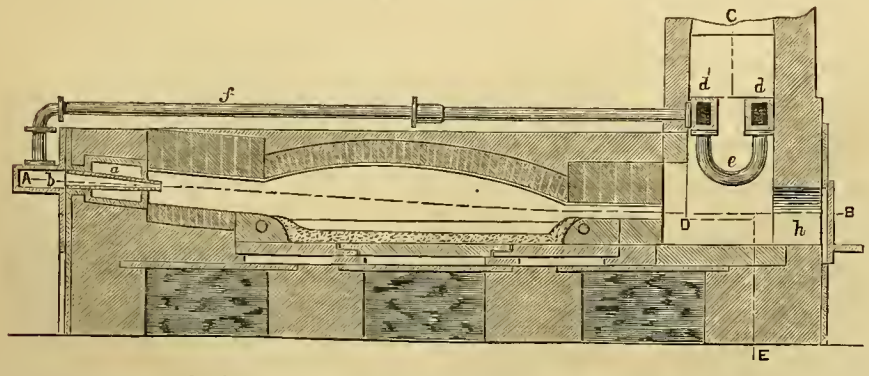
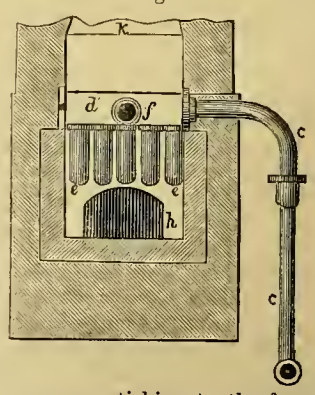



Fig. 6.




Of course, where hot blast is already at hand, and waste gases from the blast-furnace, the cockle here becomes needless, and the furnace then becomes extremely simple, and would, no doubt, prove effective. To work such a gas reverberatory best, however, the writer would be disposed to employ an exhauster-fan, placed at some distance from the furnace, and between that and the chimney-stalk, which need not then be so high as 50 feet. Having by this means the delivery both of combustible gas and of hot-blast into the furnace under complete control, which is never quite the case where the former is merely drawn in by chimney draught, he has no doubt but that many advantageous and constant results in fusing cast-iron could be secured. If such a furnace be adopted where there are no waste gases, *i.e.* not in an iron-smelting work and foundry combined—a course the writer would by no means advise—then of necessity gas generators must be put down also, which must be varied in construction &c. according as mineral coal, baked wood, brown coal, or turf (as in Carinthia) constitute the solid fuels.

We have thus said enough upon the subject of gas reverberatories to enable the intelligent iron-founder, who may find himself in position to employ them, to construct them for himself. As in the case of the ordinary reverberatories, however, our counsel is, as regards dimensions and proportions, to be guided mainly by the experience of others, reverberatory furnace building, as well as working, being to so great an extent a matter of tentation.

Though in some respects repeating what we have in this and previous articles stated, we shall conclude this paper by quoting the views of F. Karl Wiebe, engineer and professor at the Gewerb Institut of Berlin (*Handbuch der Maschinenkunde*, 1858); a well-respected authority, on the parts, proportions, and working of ordinary reverberatory furnaces.

According to this author, reverberatory furnaces for melting iron hold usually between 25 and 200 Prussian centners ($\frac{1}{4}$ to 10 tons nearly), according to size. The smallest furnaces have a capacity of 25 to 50 centners ; medium sizes, 60 to 100 centners; and the largest, 100 to 200 centners. The consumption of fuel amounts on the average, for 100 lbs. of the charge, to about 40 lbs. of coals. The loss on iron through burning away, or sticking to the furnace in "skulls," amounts to 7, 9, or sometimes even to 15 per cent., according to the time required for the melting, the quality of the fuel, and that of the pig-iron. Assuming that for the combustion of 1 lb. of good coal about 270 cubic feet of air are required, then

400 lbs. of coal would require 10,800 cubic feet of air, and the following proportions arise :—

| Charge of pig-iron | Produced matter iron | Consumption of coal | Quantity of air which has to pass through the grate |
|---|---|---|---|
| 100 lbs. | 91–93 lbs. | 40 lbs. | 10,800 cubic feet. |
| 108–110 lbs. | 100 lbs. | 43–44 lbs. | 11,610–11,880 cubic ft. |

Thus, for each 100 lbs. of iron which a reverberatory furnace has to melt per hour, 11,700 cubic feet of air, or 3·25 cubic feet per second, are required. If we suppose now the proportions of the hearth chosen in such a manner that the air can pass through the space between the fire-bars with an effective velocity of 5 feet per second, then 100 lbs. of iron melted in one hour require a free surface of the grate of $\frac{3{\cdot}25}{5} = 0{\cdot}65$ feet. The fire-bars are generally placed in these furnaces at distances of $\frac{3}{4}$ or 1 inch, so that the free surface of the grate is about 0·6 of the total area of the grate.

The area of passage above the bridge, and the area at the mouth of the chimney, may be taken as equal, and they ought to be about 0·4 or 0·5 of the area of the free surface of the grate, which gives between 0·260 and 0·325 square feet for 100 lbs. of pig-iron to be melted hourly. The area of the flue is in well-designed furnaces about $\frac{1}{8}$ or $\frac{1}{9}$ of the area of the free surface of the grate, or between 0·081 and 0·11 square foot for 100 lbs. of pig-iron molten hourly (we prefer a much larger area of chimney in proportion). The height of the chimney may be obtained by the formula—

$$H = 60 + \frac{80}{5d - 1},$$

when H represents the height of the chimney in feet, and $d$ the diameter of the circular, or (without serious excess) the side of the square area of the chimney also in feet.

The area of the sole of the furnace is $3\frac{1}{2}$ or $4\frac{1}{2}$ times larger than the total area of the grate, or 4·32 square feet for 100 lbs. iron to be melted hourly. The proportion between the length and the width of the sole is not uncommonly as 2 or 3 to 1 ; whence, to recapitulate, 100 lbs. of pig-iron, which have to be melted in one hour in a reverberatory furnace by the combustion of coals, require :

| | |
|---|---|
| Total area of the grate | 1·08 square foot. |
| Free surface of the grate | 0·65 „ |
| Area above the bridge and at the top of the chimney | 0·260–0·325 |
| Area of the flue | 0·10 square foot. |
| Area of the sole of the furnace | 4·32 „ feet. |

PROPORTIONS.

| | | |
|---|---|---|
| Free area of the grate / Total | 0·6 / 1 | $= \frac{3}{5}$ |
| Free area of the grate / Covered | 0·6 / 0·4 | $= \frac{3}{2}$ |
| Covered area of the grate / Total | 0·4 / 1 | $= \frac{2}{5}$ |
| Area above the bridge / Free area of the grate | 0·45 / 1 | $= \frac{9}{20}$ |
| Area of the flue / Free area of the grate | 0·15 / 1 | $= \frac{3}{20}$ |
| Area of the sole / Free area of the grate | $6\frac{2}{3}$ / 1 | $= \frac{20}{3}$ |
| Area of the sole / Total area of the grate | $\frac{4}{1}$ | |
| Length of the sole / Width of the sole | 2·5 / 1 | $= \frac{5}{2}$ |

The time usually required for proper melting is between three and six hours, and the quantity of iron to be melted in one hour is accordingly obtained when the total quantity of the iron to be melted is given.

The following is an example of a reverberatory furnace which melts 80 centners of pig-iron in four hours. As 20 centners, or 2,000 lbs., have to be melted in one hour, we have—

| | |
|---|---|
| Total area of the grate | 21·6 square feet. |
| Free „ „ | 13·0 „ |
| Area above the bridge | 5·82 „ |
| Area at the top of chimney | 5·82 „ |
| Side of the square chimney | 2·3 feet. |

$$\text{Height of the chimney} = 60 \times \frac{80}{10{\cdot}5} = 68 \text{ feet.}$$

| | |
|---|---|
| Area of the flue | 2 square feet. |
| Area of the sole of the furnace | 86·4 „ |
| Length of the sole | 14·75 „ |
| Width „ | 5·88 „ |
| Width of the grate the same | 5·88 „ |

$$\text{Length of the grate} = \frac{21{\cdot}6}{5{\cdot}88} = 3{\cdot}68$$

Instead of producing the current of air by a high chimney, exhausters and ventilators may be combined with a reverberatory furnace. Exhausting fans are placed behind the flue, in order to get out the hot air, and act by sucking; thus coinciding in that respect with the effect of the chimney. Ventilating fans, however, act by blowing ; they drive the air into the ash-pit, and thence between the fire-bars into the hearth ; but these arrangements have not often been adopted as yet for reverberatory furnaces.

The reverberatory furnaces destined for melting bronze are distinguished from those for melting cast-iron chiefly by the trough-shape of the sole and the peculiar direction given to the flame (to these we shall recur).

As respects the *management of reverberatory furnaces* : the charging of the furnace takes place through the charging-door constructed in one of the longer sides of the furnace, and closed during the melting by a door of fire-block hung in an iron frame. This is opened and closed by means of a lever, and is balanced for easier management by a counter-weight. The joints of this door are covered during the melting of the metal with loam or fire-clay, in order to prevent access of cold air through these to the furnace. The metal ought to be supplied to the furnace in pieces of uniform size, and if thick and thin pieces have to be melted simultaneously, the thin pieces ought to be placed upon the sole of the furnace and the thicker pieces at the top nearer to the vault; for the effect of the flame is here more intense, and a more uniform melting is thus obtained. A similar arrangement ought to be adopted for the simultaneous melting of irons of different fusibilities.

The building-up of the pig-iron upon the sole of the furnace requires some practice, especially in furnaces with inclined soles: the different pieces of the broken-up pig-iron are put in cross layers, which offer thus the necessary space for the passing through of the flame. The lower piles are also by some furnace-men placed upon fire-bricks, in order to allow the flame to pass underneath them and to facilitate the rapid warming of the sole of the furnace. A furnace which is used for the first time, or which has received a new covering arch, must be thoroughly heated before the charging. Before the furnace is charged, indeed, it ought to be made white-hot; but the charging of the pig-iron upon the sole of a white-hot furnace is connected with so many difficulties, that the material is generally charged cold or nearly so. Some saving of coal is thus gained, but the iron is now for a longer time in contact with the flame, and so loses more by oxidation &c., and alters also in quality. The charging-in of fuel takes place best about every ten minutes; it must be done as quickly as possible, in order to prevent loss of heat by entrance of cold air. If the fire is fed with fuel at much longer intervals, and a larger quantity of fuel is thus placed upon the grate, the loss of heat may be less, but there will be no uniform flame nor very satisfactory working. The molten iron accumulates at the deepest part of the sole (the sumph or pool), and is kept fluid by the flame passing over it, and when a sufficient quantity is melted, the iron is tapped off. Tapping into the ladle is almost abandoned with reverberatory furnaces. Before the molten iron is tapped out, the trap or damper at the top of the chimney should be closed, and the combustion thus moderated. The drosses and slags formed during the melting escape with the tapped-out iron, and are removed from the liquid metal after the tapping-out.

For this purpose a pool is usually made in front of the furnace, in which the liquid metal accumulates before it is passed, by a canal in sand or of loam, into the moulds. The molten iron is freed here from the drosses, generally, by passing under a dam-plate dressed with loam. After the molten iron has been run off, the remainder of the iron, with "skull" slags &c., are broken up from the sole by means of crowbars, with as little damage, however, to the sole as possible; and if the melting has to be continued, the furnace is charged again, after any requisite repairs to the sole are effected by fireclay &c. laid in with iron bars or "slices."

We had proposed to have closed the subject of air furnaces with the present paper, but it has involved a greater length than anticipated for its adequate treatment. In our next and concluding article we shall give some good examples of British reverberatory furnaces, and finish with some general remarks as to air-furnace management.—Ed.

## THE HEATON PATENT STEEL PROCESS.

*(Professor Grüner's Report.)*

Early last summer the Heaton Patent Process for iron and steel making, had attracted sufficient attention on the part of the iron masters and metallurgists of France, that a formal deputation representing some of the wealthiest and best-informed ironmasters of the Moselle—a district which through the character of its minerals and products co-ordinates, in some measure, with our own Cleveland district—accompanied by M. Grüner, the able and accomplished Professor of Metallurgy at the *École des Mines*, Paris, arrived in England, and proceeded to Langley Mills, where they witnessed the conduct and minutely investigated the results of the Heaton process repeated before them ; they also after their return to London were present at the testings of the physical qualities of the iron and steel made in their presence at Mr. Kirkaldy's testing works, the Grove, Southwark.

Monsieur Grüner, as Professor in the Imperial School of Mines, virtually represented, through that noble institution, the Imperial Government of France—though not arriving in the attitude of an Imperial Commissioner—such a course for enquiries of this sort being, we believe, unusual or unknown in the practice of the French Government.

The course taken, however, proves the anxiety of the very first metallurgic authorities, both learned and practical, to arrive at the truth as respects the Heaton process, which has excited such acrimonious and unfair criticism—not to call it by its more suitable name calumny, from its interested opponents, M. Bessemer himself and others acting for him in his and in their own understood interests ; and we may just remark that were this Heaton process the simple mixture of folly and of deception which its interested opponents have thought proper to represent it, quite enough had been long before published as to its principles—its methods and its alleged results—to have enabled those who here represented French metallurgy and French ironmasters—to have prejudged it for themselves, and if coinciding in so far with M. Bessemer and his partizans' statements—to have avoided coming to England—or making any further or personal examinations into the facts. We are therefore justified in concluding that the *à priori* views of the metallurgists and ironmasters of France were those of disbelief in the truth of the allegations made against the Heaton process which they thus deemed of sufficient importance to warrant an almost national investigation.

The investigation was promptly made and concluded, and the generally favourable results were made known to the parties interested in the Heaton patents before the departure of the commission from this country. But these conclusions were then partly verbally communicated—were all in a *quasi* confidential attitude—and altogether not in a form, to be properly and publicly available by the owners of the Heaton patents. Moreover, it was announced that immediately upon his return to the *École des Mines* at Paris Professor Grüner would carry through an exact train of analytical investigations as to the products obtained by him at Langley Mills, and that the results, in the form of a Report, would be published, and then, as it was expected speedily, would be available to the patentees.

Monsieur Grüner's duties as a professor of the *École des Mines*, involve the giving priority in right of publication of all such investigations to the *Annales des Mines*, the authorised bulletin, in fact, of the Imperial School of Mines, and as this peroidical is only published in *cahiers* at some months' interval—the time necessarily consumed by the investigation itself—and then the waiting for the above question of precedence have delayed the publication of the report of Professor Grüner or its reaching England—or the hands of those chiefly interested, until a very few weeks since.

The long delay, however unavoidable, has been of great disadvantage to the industrial progress of the Heaton process, which in the interval may be said to have stood fast, awaiting this, as we may say, judicial decision as to its merits or demerits—and as we are informed, pending arrangements not even yet fully completed between the several interests engaged in the Heaton patents.

Professor Grüner's report, however, has at length reached us, and having read it carefully, we can affirm that, drawn up with his well-known copious sources of information, experimental skill as an analyst and practical metallurgist, and bearing upon its pages proofs of sagacity and impartiality, this report cannot but be viewed by every impartial man, as in its upshot pronouncing a judgment in favour of the Heaton process ; of that process, suitably applied, directed by science and not by rule of thumb, as it appears only to have been so far, and experimentally wrought out to those ultimate ameliorations, some of which have been distinctly pointed out by Professor Grüner himself.

We regret that it is impossible for us to give within the limited space of our pages a translation of the whole of this valuable report, which in its original French occupies an octavo volume of nearly one hundred pages, illustrated by several copper-plates. We must confine ourselves to a few extracts, with brief remarks.

We are enabled to state, however, that a complete translation of the entire report has been prepared, and will, we understand, be published in our contemporary *The Engineer* paper, where, no doubt, it will be looked for with interest by British ironmasters and metallurgists.

Professor Grüner commences his report with the following introductory and historical remarks :—

"Everyone knows the defects of large masses of iron produced by welding. It is now sought to introduce ingots of iron or steel as substitutes for welded bars which are not homogeneous. The Bessemer and Martin processes produce such homogeneous ingots, the former by refining pig iron simply by the blast, the latter by a reaction of malleable iron on pig iron. But both these methods require pure pig iron, and have, therefore, a limited field of operation. To obtain cast steel or homogeneous iron from ordinary iron ores is the present desideratum of ironmasters. The two elements which most impair the tenacity of iron, or, at any rate, those which most contaminate common iron ore, are phosphorus and sulphur. To get rid of these two substances, either from the ore or from the pig, is the problem for solution.

"Sulphur, we all know, is not in general hard to eliminate. The best Swedish ores are Pyritose, and, nevertheless, produce excellent iron. It suffices to roast them carefully, and then treat them in the blast furnace with an excess of flux, and, if need be, with the addition of manganese.

"The difficulty in eliminating the phosphorus is greater. Theoretically it would not seem impossible to extract it from the ore itself, at any rate, when, as frequently happens, this element is found in the condition of phosphate of iron.

"Carbonate of soda, in fine, decomposes the phosphates of iron. But if the process is possible in theory, it appears to me to be almost impracticable on a large scale. The prolonged lixiviation of such large masses, without going into the cost of the reagent itself, would be embarrassing ; the cost would be disproportionate to the present low value of wrought iron. Besides, we know of no reagent which can hinder the combination of phosphorus and iron during the reduction of the ore. We are, therefore, compelled to attempt the dephosphorisation of the pig itself. We succeed partially, either by the puddling or the refining process ; but only on condition of always operating under a bath of *basic* slag. So soon as

the slags contain forty per cent. of silica, the bases no longer retain the phosphoric acid—phosphuret of iron is continually being reproduced. This is what happens in the Bessemer convertor and the Marten reverberatory furnace, where the slags, thanks to the high temperature and to the fire-clay lining of the chambers, are always charged with an excess of silica. If it be not so in the puddling furnace, and even in the refinery, we must attribute the fact to the chilled-metal lining of these furnaces, which allows of the formation of slags, which are at the same time basic and charged with an excess of oxides. In the puddling furnace, the dephosphorisation is, moreover, facilitated by the material of the hearth and the fettling, which supply the slags with peroxide of iron. In the refinery furnace the reducing action of coke is more than compensated by the energetic action of the blast, which not only acts directly on the pig, but also is continually imparting excess of oxide to the protoxide of iron in the slag, and so by this twofold action renders it more or less basic. This effect of the lining of the furnace on the dephosphorisation of the pig, has just been newly verified by experiments made at Königshütte, in Silesia. A Bessemer convertor was put up at these works in 1865, and they endeavoured to convert the pig irons of the district, which are more or less phosphoric. The products obtained could be rolled, hammered, and welded, but when cold would not stand blows. They had to give up using them for tires, springs, &c., although it was found possible to use them for rails. It was then attempted to get rid of the phosphorus by a preliminary refining; for that purpose the well-known gas furnace of M. Eck was selected. It is, as is well-known, a reverberatory furnace. with a concave hearth, heated with gas, and provided with tuyeres, which project numerous jets of blast on the bath of pig. The pig experimented on contained a half per cent. of phosphorus (·00497). A first experiment, taken immediately after the simple melting, gave ·00514 of phosphorus; a second, taken after three hours of the refinery, ·00570. As in the Bessemer converter, all the phosphorus was concentrated in the refined metal, and that in proportion to the waste caused by the refining. M. Wedding, who gives the results of these experiments, does not give the analysis of the slag produced; but it is clear that it must have been silicious, like the slags resulting from the Martin process; and this state of things could only be remedied by adding oxide of iron, for, if the temperature be high, the oxide is rapidly reduced by the pig, or turned into slag by the lining of the furnace. The argilo-silicious character of the lining and of the hearth, completely prevents the elimination of the phosphorus. This, by the way, is the grand defect of the sand hearth in the puddling furnaces.

"Puddling proper was then substituted for the refining, but they committed the mistake of puddling at a high temperature in a balling furnace, instead of dry puddling. In this case too, the crude iron still retained 0·001 of phosphorus, which is too much for good Bessemer steel. The crude iron thus obtained was nevertheless remelted in the cupola by Dr. Parry's method, and the metal, recarburised by such remelting, run direct into a Bessemer converter. The operation so conducted is not impracticable, but the molten iron lacks silicon, and the cost is too heavy. The Parry process is really only practicable, so far as cost is concerned, if the phosphorus be eliminated by the finery, as I proposed in my 'Essay on Steel' in 1867, page 106; but this refining, as I then said, should be done under a layer of basic slag.

"Our scientific master, P. Berthier, has long since shown that this purification is, at any rate, partially realised in the English finery ("*Traité de la Voie sèche*," vol. ii., page 289, "Analysis of Dudley Finery Slag"), and the fact was put beyond doubt in 1833 by Mr. Thomas, an old pupil of the School of Mines, at the Décazeville Works. It is, nevertheless, certain that it would be better to try the dephosphorisation in a reverberatory furnace, avoiding contact with the fuel, only it would be necessary to build this furnace like a puddling furnace, with a hearth and a lining of cast iron properly cooled and fettled with oxide of iron. This is what an English ironmaster, Mr. Samuelson, of Banbury, has quite recently tried. His furnace is provided with a cast-iron hearth covered with a layer of roasted scrap iron, to facilitate the running of the refined metal. The hearth is made movable; it is balanced on a horizontal axis, and can be inclined to the ingot mould. The hearth is renewed, or at least repaired, every eight heats by adding 100 lb. of fresh scrap iron. The pig, remelted in the reverberatory furnace, or brought directly from the blast furnace, is exposed to the reaction of rich protoxide of iron employed alone or along with more or less sea salt. The metal so purified is then puddled in the usual way, or converted into cast steel in a Martin-Siemens furnace. The patentee affirms that a ton of steel refined by 3 cwt. of magnetic oxide, containing 58 per cent. of iron, yields from 19½ to 20 cwt. of fine metal; that in treating Cleveland pig the phosphorus is reduced from ·012 to ·004, and that bar iron, obtained by puddling this refined metal in the ordinary way, retains only ·0010 of phosphorus and ·0005 of silicon.*

"This result, imperfect as it is, is nevertheless a fresh proof of the possibility of at least partially dephosphorising in the finery when the furnace and the bath of slag fulfil the conditions above prescribed. But to arrive at a more perfect purification we must employ reagents more energetic than oxide of iron—we must have oxide of manganese and alkaline matters. We know, moreover, that these reagents have been tried at different times. In the above-cited essay of Mr. Thomas lime and oxide of manganese are mentioned as having been employed in the fineries of the Décazeville Works. In the experiments in question it was ascertained that these two substances favour the elimination of sulphur, phosphorus, and silicon. But let us remember on this head, that if there was an energetic elimination of phosphorus, and if the slags contained 4 to 5 per cent. of phosphoric acid, the fact was solely due to their basic condition. The proportion of silica they contained was not more than 30 per cent., that is also, by the way, the per centage of silica in the phosphoric slags of Dudley, given by M. Berthier, whom we quoted just now.

"We have also as a purifying agent the powder made by Dr. Shafhäutl, of Munich, composed of sea salt and peroxide of manganese, and long used in the manufacture of puddled steel.

"About the same time, in my lithographed *Lectures to the School of Mines of St. Étienne*, 1844 (p. 191), I suggested the use of crude tartar and alkaline carbonates for the purification of pig-iron. Later MM. Fontaine and Dû Motay recommended for the same purpose the hypochlorites; and in England Sir F. Knowles took out a patent in 1851 (No. 1921), for the use in the puddling furnace of various reagents, such as the nitrates and other salts of soda or lime. But all these reagents are difficult to use in reverberatory furnaces. Their small specific gravity and their volatile character cause the reaction to be very imperfect. The contact between such matters and the pig is entirely superficial; all the art of the puddler is unavailing to effectually counteract this objection. The object to be achieved is to render the contact more intimate. Among the experiments made in England with this view we have to cite those of M. Korshunoff, and more particularly the very simple process of Mr. Heaton. M. Korshunoff, a young Russian engineer, settled at Birmingham, took out his first English patent September 26, 1865, and his second November 10, 1866. He proposes different contrivances, which all aim at facilitating the reaction of various carburising or oxidising reagents, such as mineral oils, nitrous vapours, salts, hydrochloric acid, &c. on pig-iron and malleable iron. But all these contrivances are more or less complicated, and seem to me to realise but imperfectly the object in view. The one to which M. Korshunoff seems to attach the most importance is a sort of low Bessemer convertor, so arranged as to act as a puddling-furnace when in an horizontal position. The operation is commenced as in the Bessemer convertor, only with this addition, that the reagents above enumerated, whether liquid, solid, or gaseous, are introduced with the blast. The operation is finished by puddling the metal so refined in the ordinary way. The product would, consequently, be a bloom, and not an ingot. It is a retrograde movement in comparison with the Bessemer and Martin processes; and, as far as his purification by chemical reagents is concerned, the memoirs and pamphlets published by the inventor cite no trials tending to establish the efficacy of his proposed methods.

"Mr. Heaton's English patents are dated March 17, 1866 (No.

* We believe there is at present great reason to doubt that these results have been realised.—Ed.

798), May 3, 1867 (No. 1295). Mr. Heaton uses nitrate of soda more particularly, but not exclusively. But the chief characteristic of his process is the ingenious contrivance which causes the gases resulting from the decomposition of the nitrate to pass in thin jets through the molten metal, so as to multiply the points of contact.

"It may be asked whether this intimate contact would not be brought about just as well by the blast in the Bessemer convertor, since at Neuberg, in Styria, they have successfully introduced coal with the blast? One might, indeed, so inject, on M. Korshunoff's plan, various alkaline salts, such as nitrates and carbonates, &c.; and Mr. Bessemer himself has lately taken out a patent with the same object in view (December 31, 1868). But I think I can answer for it that, as far as phosphorus is concerned, the purification would be altogether illusory under the conditions on which the Bessemer convertor is worked. The alkaline base would seize upon the silica and would set the phosphoric acid free to be again reduced by the iron. If, on the other hand, to avoid this disaster, we were to augment the proportion of base so as to restore 30 per cent. of silica to the slag, we should infallibly destroy the lining of the convertor. At these high temperatures the refractory linings do not resist the corrosive action of basic slags, the only ones, as I said before, which allow the phosphorus to be efficiently expelled in the form of phosphates."

Professor Grüner then proceeds to the description of the Heaton process as conducted before him—accompanied by Mons. de Wendel, and the metallurgic representatives of Baron d'Adelswärd—both of the Moselle, at Langley Mills.

Into this we need not follow him, because our readers have had ample details of the process already laid before them; and then he goes on to the train of analyses made of the products and educts and to the discussion of the results, into which, as in fact occupying the bulk of his large pamphlet, we are unable to follow him through want of space. He treats in succession—of the so-called "crude steel" of Mr. Heaton's nomenclature—and of the iron rolled from it, and of the cast steel made from it after being formed into "cakes,"—and then discusses the results as to tensile strength—derived from the "work done" upon the materials at the epoch when the elastic limit is reached, and gives several tables of experimental values, both absolute and comparative, with well known "brands" of iron and steel, &c.

For these we must refer to the original. We can only give the remaining portion of the report, which is pregnant with important matter, and which rightly considered ought in our opinion to cause British iron and steel makers to pause before they finally reject the Heaton process—the rather as since we last wrote upon this subject, the modification of the Siemens-Martin process adopted by Mr. Samuelson, and from which as a rival so much was anticipated, has, it is said, proved a decisive failure—at any rate has, as we are informed, been abandoned.

We may add, that Professor Grüner with his adequate knowledge of the geological and mercantile conditions of the question—expresses his decisive opinion—that a largely increased demand for nitrate of soda, from South America, where its supply is boundless—would result in a considerable reduction in price, in place of an enhanced one, as put forward by the British opponents of the Heaton process. Reverting to the report, M. Grüner says:

"But let us return to the Heaton process for the treatment of the common brands. These are modifications, the adoption of which, in my opinion, would permit its practical application to the production of rail metal from these brands.

"1st. The molten metal should be run direct from the blast furnace into the finery furnace, as is done in several Welsh works, or better still, into a *boiling* furnace, to be refined by blast and oxide of iron.

"2nd. Thence the refined metal should be run into the Heaton convertor to be treated with nitrate.*

"3rd. Then the metal, twice refined, should be passed at once, whether fluid or solidified, into the Martin-Siemens furnace to be converted into soft cast steel, or homogeneous iron, by being mixed with malleable iron or Spiegeleisen. Let us add, that if we carried the refining in the convertor as far as true decarburisation, the refined metal could be charged into the Martin furnace instead of malleable iron. That depends on the degree of purification attained. We see that by this mode of treatment we should adopt that valuable principle of progressive refining which I long ago recommended in my work on steel (p. 106) for the treatment of the common brands.

"It is unnecessary to add, that if the pigs only contained 1 per 100 of silicon, and $\frac{1}{4}$ to $\frac{1}{3}$ per 100 of phosphorus, we might dispense with the first finery and run the metal direct from the blast furnace into the Heaton convertor.

"We have still to prove that the cost of this double finery would not be disproportionate to the value of the product we should expect to obtain.

"The average waste of the finery is from 8 to 10 per 100. But this waste would be reduced if we added rich ore to the molten metal. I will assume it to be reduced to 5 per cent. On the other hand, the average consumption of coke in England is from 200 kil. to 250 kil. (say 440 lb. to 550 lb.) per ton of refined metal, when the molten metal comes direct from the blast furnace, and would be 400 kil. (say 8 cwt.) of coal if we were to work in the same way in the reverberatory furnace. The cost of manual labour and incidental charges vary, as we know, from 2s. 6d. to 3s. 4d. per ton. Taking then the actual price of the Moselle forge pigs, we should have for every ton of refined metal—

| | Fr. | £ | s. | d. |
|---|---|---|---|---|
| 1 Ton of forge pig at | 63 | 2 | 10 | 0 |
| 5 cwt. of coke at | 7½ | 0 | 6 | 0 |
| Labour and incidental expenses | 4 | 0 | 3 | 4 |
| Total | 74 50 | 2 | 19 | 4 |

In the reverberatory furnace we should have 400 kil. (say 8 cwt.) of coal at 12fr. or 10s. (say 4·80fr. instead of 7·50fr., or 4s. instead of 6s.), which would reduce the price of the refined metal to about 72 francs (£2 17s. 4d.). This is the cost we will assume, because refining in the reverberatory furnace is always more effectual than fining on the hearth.

"The pig so refined would waste but very little in the convertor, because the silicon and phosphorus would be to a great extent eliminated. We may take 5 per cent. as a maximum. If, on the other hand, we assume that we have to oxidise 0·003 to 0·004 of silicon, and as much phosphorus and sulphur, and about 1 per 100 of carbon, we should need 20 kil. to 22 kil. (say 44 lb. to 48 lb.) of oxygen, which would take 1 cwt. of nitrate. The cost would then be—

| | Fr. | £ | s. | d. |
|---|---|---|---|---|
| For 1 ton of refined metal at | 75 60 | 3 | 9 | 0 |
| 1 cwt. of nitrate at 400 fr. per ton | 20 | 0 | 16 | 0 |
| Labour and wear and tear, &c. | 4 | 0 | 3 | 4 |
| | 99 60 | £3 | 19 | 4 |

With the expenses of management and royalties, we should so arrive at a maximum cost of 110 francs per 1000 kil., a figure which would be reduced to 100 francs, or £4, if the price of nitrate were to be reduced, as is probable, or if cheaper chemicals were to be partially substituted for the nitrate. Now, we know that the average price in France of brands suitable for the Bessemer and Martin processes is 115 to 120 francs. There would, therefore, be a certain amount of profit in using nitrate for the purification of common brands. It remains to be proved by new experiments, if rails so made would possess, as I believe they would, sufficient (*résistance vive*) elasticity.

"I have just said that the cost of the refined metal might be lowered if we were to substitute cheaper chemicals for some portion of the nitrate. Let us go into some details on this question.

"In the first place, we might to some extent substitute carbonate of soda for the nitrate. This salt has an oxidising effect by its carbonic acid, which is reduced to carbonic oxide. Its available oxygen is 15 per 100 instead of 44 per 100. But the proportion of base which would take up the acids is 58 per 100 instead of 34 per 100. From this point of view there would be something to be

* We know that in some works in Wales the refined metal is run directed to be refined with charcoal into a low (comptois) hearth.

gained by mixing these two salts. The experiment was tried, on my suggestion, at La Vilette—instead of 10 per cent. of nitrate, 9, 8, and 7 per 100 were used successively with 1, 2, and 3 per 100 of carbonate—the phenomena of conversion were the same, but the reactions were less violent, and the metal also seemed less modified. The analysis of the products is not yet finished ; I cannot, therefore, be positive as to the results.

"Again, to augment the per centage of oxygen while reducing the cost, I caused peroxide of manganese to be mixed with simple nitrate and with nitrate and carbonate. This oxidising reagent had also been tried by Mr. Heaton at Langley Mill. It was given up because the temperature developed is not always high enough to melt the protoxide, and that the product is then a pasty mass and the slag not homogeneous. The oxygen liberated is in fact 18 per 100 at best, sometimes only 12 or 15 per 100. In spite of that, the conversion is quite as successful when we content ourselves by substituting an equal weight of peroxide for about $\frac{1}{3}$ or $\frac{1}{4}$ of the charge of nitrate. But we must take care that the mineral should be pounded fine and thoroughly mixed with the nitrate or carbonate and nitrate.

"Mr. Heaton at first used a mixture of nitrate and slaked lime. This was done in July 1868, when Dr. Miller and Mr. Mallet went to Langley Mill to investigate the new process. The lime acts as a strong base, but renders the slag more pasty. That is a disadvantage. If we wish to arrive at running the metal direct into a Siemens furnace, we must have fluid silicates, so that the metal may disengage itself from the slag. This end is attained by substituting fluor spa for lime, as Mr. Heaton has himself lately proved at Langley Mill. My only fear is that some little sulphur might be introduced into the metal with the fluor spa, which almost always contains sulphate of barytes.

"We can render the slags perfectly fluid without running the same risk by mixing common sea salt with the nitrate. The experiments I have just had tried at La Villette prove the efficiency of chloride of sodium. With mixtures of 7 per 100 of nitrate and 1 to 2 per 100 of sea salt the slags become as liquid as water. The phenomena of conversion are just as usual, except that there is an abundant liberation of suffocating vapours. The sea salt is volatilised with other chlorides. But these chlorides probably themselves effect some purification of the refined metal. That is a matter still under examination. In any case 1 to 2 per 100 of sea salt will always be very useful to increase the fluidity of the slags of the convertor.

"In fine, we see that there are still questions for examination, and that it may be advantageous to add other reagents, either as fluxes or oxidisers, to the nitrate.

"I have but one other point to speak of, viz. the arrangement of the apparatus. The convertor is very simple. The molten metal can be easily run into it, either by a trough or by a crane ladle, or by a waggon running on trams. The most troublesome part of it, at any rate when converting on a large scale, is the manual labour and the fixing of the nitrate chamber ; but a little tramway passing under the convertor would allow of its being run into its place, and, instead of attaching the chamber to the convertor by clamps, one might use a hydraulic lift, which would hold it tightly in its place during the conversion. After the conversion the nitrate chamber with its contents of refined metal would be removed in the same way to the Siemens furnace, where the treatment for steel would be finished.

"Having now arrived at the end of my long essay, I think I should sum up the principal results.

"*Conclusion.* The Heaton process could never from any point of view be a substitute for the Bessemer and Martin processes. These produce ingots of steel or homogenous iron from pure brands. The Heaton process deals with impure brands and seeks to convert them into a refined metal more or less purified, the treatment of which has to be finished in a Siemens furnace. Its aim is to preserve for the common ores the place which the pure ores have for some time tended to usurp.

"Iron and steel for springs, tires, large guns, plates, should be left to the pure ores ; rails and bars of homogenous iron more or less hard, to the common ores.

"The purification is based on the reaction of Peruvian nitrate of soda. The apparatus is simple, ingenious, and very cheap. The operation is rapid, easy to manage and not liable to explosions.

"The nitrate refinery acts like the ordinary methods based on the employment of air or the metallic oxides. The silicon and manganese are first oxidised, the phosphorus and sulphur are eliminated next, the carbon last.

"The degree of purification depends, of course, on the proportion of nitrate. But we should hardly be able to achieve an absolute purification even with 12 to 15 per cent. of nitrate.

"To reduce the cost we must use brands which contain little silicon and generally use refined pigs rather than crude pigs.

"The greater part of the silicon and phosphorus ought to be eliminated by a preliminary refining. This ought to be done on the low hearth, or better still, in a reverberatory furnace. In any case in a furnace with a lining of properly chilled cast iron, and with the aid of roasted scrap (*riblons*) or natural oxides of iron, so as to leave the molten metal always exposed to the action of strongly basic slags. Even the pure silicious brands which are meant to be made into cast steel by the Siemens-Martin process ought to be treated to a preliminary refining.

"The Moselle brands were converted at Langley Mill without any such preliminary refining, and with an insufficient dose of nitrate. The result was a refined metal retaining still in the most favourable case as much as 0·005 of phosphorus, 0·0014 of silicon, and 0·012 of carbon. This metal was converted partly into malleable iron by a quick puddling, partly into cast steel by reaction in crucibles. Neither of these methods is economical. The only advantageous method is the conversion of the metal in a Siemens furnace into homogenous iron or soft steel by the Martin process.

"The cast steel made in the crucible from the insufficiently refined Moselle crude steel still retains 0·002 to 0·004 of phosphorus 0·0014 to 0·0018 of silicon, 0·003 to 0·004 of carbon and traces of sulphur. In spite of this the steel works well hot, and gives good results when tested by slow tension, but its elongation is small, and this would seem to indicate a want of (*résistance vive*) elasticity.

"If the process were modified as I have suggested, the results would probably be different. At any rate, further experiments are requisite before we can definitely pronounce upon the elasticity (*résistance vive*) of the bars prepared by the process ; and on the other hand it is certain that the Heaton process, properly carried out, would seem to realise the purification of common brands better than any other known method. We are not, however, as yet in a position to affirm that the purification is as complete as we could wish."

In conclusion, we would especially call the attention of those of our readers chiefly interested—*viz.* those in the iron trade, to the calculations as to the mercantile cost of the Heaton process, conducted according to the modification which M. Grüner recommends, given in some detail by the author in his report, as being a decisive answer to the objection urged with so much pertinacity by the opponents of the Heaton patent—*viz.* that under no conceivable conditions could it be conductively remunerative. This M. Grüner has certainly shown to be untenable.

## THE NEW EDUCATIONAL ESTABLISHMENTS OF PRUSSIA FOR PURE AND APPLIED CHEMISTRY AND PHYSICS.

Whilst we in England are *talking*, and as yet at least, little more, about technical and other education, France, Germany, and even Switzerland are active and *doing* ; doing, although they had already done far more each respectively in the way both of general and of technical education for their populations than we are likely to reach up to even a quarter of a century hence, if indeed we shall ever now get up abreast in the race in which we have so much fallen to the rear.

Our aim at present, however, is not to deal with the educational question in its technical aspects generally, but to draw attention to the superb apparatus by which Prussia is at present commencing the career which she has marked out as best befitting this epoch of her own and of the world's advancement. She bases her action on this, that what is called elementary education, however good, will not alone suffice any longer to enable any European nation to take and hold a first place, but that a very widely-diffused and

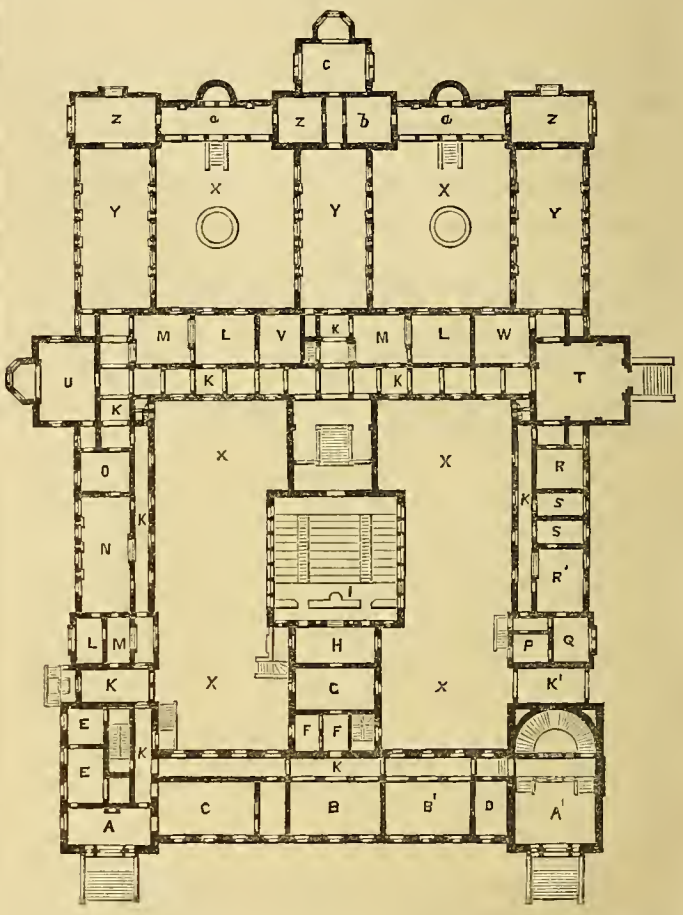
accurate knowledge of the properties and powers of the material world around—that is to say, of physics and chemistry—is indispensable to the great bulk of the people. It is sought at once to render a certain amount of sound and real knowledge of these fundamental sciences of observation, not only easily and cheaply accessible to all who shall have acquired a fair amount of common education, but in reality to sow, as if broadcast, such science thoroughly, though within limits, amongst the people. This idea looks to fruit in more ways than one; it rests upon the sound notion that every mind, so far as it is at all trained to true scientific methods of thought and observation, is more powerful for its own good and that of the commonweal than without; that the mind so trained cannot, rightly understood, be a worse companion to the man, morally or religiously, than if left unhabituated to the methods and without appetite for the ascertainment of truth, and its careful and wistful separation from falsehood or superstition. That, out of the vast phalanx of young and eager minds so trained that every year shall produce, many must come to the front, having found such studies congenial, and prove eminent and successful, on the one hand, in applying their knowledge of nature and history to practice in continual improvements of arts and new or advanced methods of manufacture, or, on the other, as philosophers proper, men of research, whose labours and their results are to become in turn the food for the practical applications and fruitfulness of a still later generation. With these views Prussia has (as we have ere now noticed) established three great national laboratories, and intends to form several more, destined for a two-fold end: first, to afford the means upon a broad, adequate, and complete scale, of physical and chemical education up to a certain point to a large proportion out of the total educated youth of the nation; secondly, to present the means for the further pursuit of these sciences, in experimental physics, chemical analysis &c., to such of the students as prove capable and warrant or desire, a scientific technological career; and, thirdly, we may add, to present the means to physicists or chemists who have already shown their powers or won distinction, to pursue at the national cost enquiries demanding, besides devotion and time, more costly means in materials or apparatus, or both, than private purses usually can command. We may even add a fourth object—namely, to give the means of pursuing trains of research with a view to the ascertainment and fixing of physical or chemical constants, such as those upon heat, of Fabre and Silberman, or of Regnault on steam &c., or of deciding great problems of an industrial nature which are liable to become obscured or misrepresented by individual interests, or are too large to be handled by private experimenters; such, for example, as inquiries relating to the very varied, and often far from well-directed, methods of wine-making of the different wine countries of the world.

The commencement of the material apparatus for this grand advance has been made at Berlin, Leipsic, and at Bonn. About 20,000*l.* has been expended upon the building of the great laboratories in the capital of Prussia, about 16,000*l.* on those of Bonn, the seat of a large and energetic University, and about the same at Leipsic; in all three, with the characteristic economy in getting the worth of their money which characterises Germany. It gives but a very imperfect idea of these great establishments to call them *laboratoriums*; each is, in truth, a grand and many-sided academy, and when, within the next few years, fully carried out and earnestly at work, will present a nearer resemblance to the "New Atlantis" imagined by Bacon than anything perhaps that the world has yet seen.

The five grand *laboratoires des hautes études*, which the French Government has since 1867 established in France, are intended chiefly to fulfil the last above described of the functions of these German academics. We have in a previous part of this Journal noticed these establishments at some length. They are very nobly conceived institutions, and cannot fail to exalt still further the justly high character of French experimental science; but the aim of these German "Academies of Experiment" is more comprehensive, and will, it seems to us, produce a more profound impression. We annex a ground-plan of the establishment at Bonn, which will best convey to our readers an idea of its capabilities.

As we walk from the town and University buildings of Bonn by the Grande Allée towards Poppelsdorf, where in that ancient archducal palace are lodged the natural history collections of the University, about half-way along those long rows of old horse chestnuts, upon the right hand, and not far from the house where Prince Albert lived in his student life here, we see the large frontage of a handsome three-storied building in a somewhat severe German style of Greek architecture; these are the laboratories and their accessories. The building is of brick and cement; the lower story, or cellars, which is half sunk only and very lofty, is all arched, and the entire structure is practically or sufficiently fireproof; all the floors nearly are laid in coloured tiling.

Ground Plan, principal floor, of the Rhenish Chemical Institute, of the Frederick William University of Bonn.




There are four interior courts marked x x on the ground plan of the principal story here given. This story contains the chief working portions of the establishment. The basement story, besides fuel vaults &c., is destined to form a large suite of experimental workshops so to say, in which metallurgic processes—dyeing, cotton printing, brewing, sugar or wine-making—and, in a word, anything of the whole line of arts or manufactures, may be conducted on a large scale, and with a view to practical enquiries. The upper floor contains the dwellings of the director, of the housekeeper, of the professors, and of the immediate servants of the establishment, and also certain store-rooms &c.

If the building be imagined divided the longer way by a line down the centre, the right hand is chiefly dedicated to physics, and the left to chemistry; but these interlace, as it were, in several ways. Commencing at the lower part of the plan and at the main front of the building, A′ is the grand entrance and that of the residence of the director; A at the opposite flank being that of the *Hausmeister*, or keeper, with its rooms E E and corridor K leading to the interior &c.; D is the director's official reception room; a long corridor K connects these wings, and between them are B′ and B, the great rooms—for preparation and for apparatus—a realising in fact of what has been so well, but still incompletely, attempted in the large chemical and apparatus museum of King's College, Lon-

don; C is the smaller lecture room, with its professor's chamber attached, in which chemistry and physics can be alternately taught. Corridors K and K give access from outside to the interior courts and to the buildings just behind the director's and housekeeper's residences. Following up the central range of buildings, I is the great central lecture room, reached from all parts, by pupils &c., by the fine staircase seen above it in the plan. This noble theatre is fitted up with excellent taste, and nothing that the best skill, workmanship, and materials of the day can afford has been spared in its fittings. The room is about 40 feet square and about 30 in height; ample room and convenient desks to the rising seats, excellent light from windows high up at both sides the entire length of wall, the means of producing perfect darkness in a few moments, and the power of hearing in it perfect. The walls, like those all through the building, are frescoed on the hard smoothed cement plaster, and the ornamentation in a Greco-Roman style of polychrome stencilling in excellent taste. The lecture table is covered with heavy slabs of ground (roughened) plate glass, and possesses a pneumatic trough that a big man might bathe in, and two mercurial troughs, holding each about a hundredweight of quicksilver; behind the lecture table are H the preparation room for lectures; G the apparatus room, fitted with large glass cases, in which all the large established apparatus for chemical demonstration is kept ready mounted; F F are rooms for the professor before or after his lecture, also serving him as an audience chamber.

On the left hand we have N the laboratory of the director, which in fact corresponds to that *des hautes études* of the Paris institutions, with O the consultation room and writing room, with books of reference; L is the balance room; and M that for combustions &c. by gas or solid fuel; the corridors in line K K put all this in connection with U the director's private office, or study, and with the rest of the building; this corridor in fact continues by K K K all round the interior courts, and reaches at T, the common hall of entrance and exit for the pupils, or students; the closets and urinals &c. next below, in the fig. We have at R the physical laboratory, with S S rooms for experiments on heat and light requiring gas and the power of excluding light &c.; R′ is the private laboratory (or, again, that *des hautes études* of the physical professor), Q and P being apparatus rooms.

Proceeding now to the upper part of the plan, we have on the left Y the grand laboratory for students, devoted in their first *semestres*, to *qualitative* analysis, and at the right the corresponding one for *quantitative* analysis. Each of these will accommodate with separate table, apparatus, reagents, gas flames &c. &c., twenty students. We cannot spare space to go into the details of their fittings up, but they are worthy of unqualified praise. Each laboratory is extremely lofty and admirably ventilated and warmed —forced ventilation being obtainable at will. In the centre is the great laboratory for advanced students engaged in *special researches*.

Thus, no less than *sixty students* alone are amply and comfortably accommodated, and studying at the same time in those three laboratories alone. M and M are combustion and furnace rooms for these laboratories respectively, and L and L the respective balance rooms; W is the room for hanging up coats and laboratory working clothes &c., and near it are lavatories; Z Z and Z are rooms for special operations attached to each laboratory respectively; *a* and *a* open corridors to which the students can retire between waiting times of operations &c. for conversation or fresh air, or whence they can descend into the courtyards X X, with their central fountains and grass &c.; *b* is the general store room for reagents; and *c* is a laboratory specially fitted up and devoted to the teaching and practice of *volumetric* analysis. Directly below (in the plan) these three great laboratories we have the small chambers, or offices, for the constantly present "assistants," or laboratory superintendents, who, so far as the laboratory is concerned, correspond to "répétiteurs" in France. We also have the library common to the whole establishment, and already furnished with a fine array of nearly the entire working armoury of the literature of all nations in physics and chemistry.

The establishment already contains a great deal of valuable apparatus, much of it of the most expensive and important classes. Balances by the first makers of Germany, air pumps, from huge to small, by Deleul, of Paris, and others, noble spectroscopes, and what not besides; and is complete as to all required for efficient student work, though much more is wanted before it will be complete as to all its future wants for the higher studies. The reagents thus are complete also, and there has been a good commencement made for the future museum of chemical products and preparations —many of these are already there of excessive rarity—and, no doubt, in a few years these collections here and at Berlin, will at least not be surpassed anywhere.

Nothing almost has as yet been done to fitting-up the more ponderous apparatus that hereafter will occupy the basement in the way we have described, except that admirable arrangements exist in it for the supply of water to all parts and levels of the building; for the production, storage and supply of distilled water, and for the warming and ventilation, a steam-engine will do all the drudgery. When in complete working-order, in accordance with what is intended, each of these *laboratoriums* will be in fact a real university of physical science, employing the term in its largest sense. It will embrace a teaching and experimenting staff, not of one, but probably of at least twenty professors; three, probably, including the director, of the highest grade, six others, and the remainder répétiteurs &c.; and will secure means of education or research for probably not less than *one hundred and fifty* students in all.

Let those who know what our chief and best London schools of chemistry are, ponder whether our talk about education had better not be changed (in presence of what we have above but sketched in the barest way) into immediate action. How great the difference, for example, between these noble halls of science and of study, and the truly humiliating spectacle afforded by the educational apparatus— the best, probably, in London—which is presented to our English youth at the Royal College of Chemistry in Oxford Street, with its small, low and stiffingly ill-ventilated and unwholesome laboratory, already at this early period of the present session (November 4) choke-full of students elbowing each other, and yet whose total number probably does not reach twenty. Yet this is the chemical educational apparatus of no less than "the Royal School of Mines" of England. How unworthy of the nation—of the talents of Professor Frankland, who presides within its insufficient walls—and of the zealous labours and vast ability as a chemical teacher and operator of Mr. Valentine, whose skill and gentle manners have had so marked an effect on the reputation of this laboratory since its foundation by Dr. Hofmann.

But South Kensington here, as everywhere, crops up, all-grasping, all-absorbing, regardless of everything but aggrandizement, and the shells of certain half-finished laboratories are said to have been there quietly in progress, but to be now stopped, probably by the same unseen forces that have turned the Royal Society out of its old house, and now stopped short in completion—of its promised new one. No doubt these are meant in the end, and when the right time comes for the shell to burst, to absorb Oxford Street and Jermyn Street, and bring these, with the whole "School of Mines" also, to South Kensington; but can it be that no independent member of the House of Commons will rise up and protest against the monstrous absurdity of establishing chemical laboratories at that out-of-the-way, and, to all but idle *dilettanti*, unreachable place; laboratories so placed that those who want them shall be unable to use them.

What a wonderful and incomprehensible thing "the wishes of the late lamented Prince Consort" must have been, if they be truly represented by the acts of those who have congregated on "the estate" at South Kensington, horticultural gardens, so called, museums of *omnium gatherum*, patent and otherwise, portrait and all other exhibitions; Cole-essæums with no assignable use, cænotaphs, a naval (!) school, periodical shows, perennial jobbery, and would finish with a chemical laboratory, and, in future, if it can, with the School of Mines and the British Museum.

## OXYGEN GAS AS A NEW MANUFACTURE—ITS USES FOR HEAT AND ILLUMINATION.

The chemical characters of oxygen have been so precisely fixed since its discovery, that there appears absolutely no chance of adding more to the history of our vital element. If science,

however, directs at present its interest exclusively to another oxygen, the *extraordinary* oxygen, so improperly called "ozone," industry takes possession of *ordinary* oxygen—the element essential to fire, in order to effectuate the most complete combustion possible of fuel. It is truly interesting to see our chemists almost spontaneously setting to work to produce that *ordinary* oxygen in abundance and cheaply, which until now was only prepared in small quantities, exclusively for the requirements of laboratories, and at fabulously high prices. A practical interest was necessary for the solution of the problem of *the cheap production of the oxygen*, and indeed, within a short period, several solutions have been presented, which, as a remarkable fact, are all simple, ingenious, and practical.

Can anybody at the present time deny the progressive influence which industry exercises over science? The very natural axiom, *Necessity is the condition for creation*, will always be applicable to the origination of every great improvement. In order to understand thoroughly the interest presented by our subject, it is advisable to consider oxygen *ab ovo*, which will permit us to rectify some mistaken ideas as to the antecedents of its scientific history.

The discovery of oxygen is generally attributed to Priestley. This celebrated chemist obtained that gas by concentrating solar light on red oxide of mercury (*precipitate per se*), by means of a powerful lens; but oxygen was known, although imperfectly, before Priestley. A learned experimenter, worthy the title of chemist, Eck de Sulzback, showed, in the fifteenth century, that metals increase in weight after they have been heated; he calls the metallic oxides "fixed ashes" (November 1489), and says, "this increase of weight is effected by the union of a spirit with the body of the metal, and the proof of it is that artificial cinnabar (red oxide of mercury) when heated releases a spirit." If this learned chemist of olden times had called that *spirit* oxygen, the science of chemistry would have been in advance by two centuries. Cardan speaks, in 1501, of a spirit which feeds flame, and Césalpinius, in the year 1602, says that the dross which covers the surface of lead when melted comes from the air. At a later time, Jean Rey calls attention to the increase of weight which tin sustains when heated in air. Finally, in 1774, we find the capital experiment of Priestley, who extracts from the so-called artificial cinnabar the gas supporting combustion which received the name of oxygen afterwards.

During many years, oxygen had not been otherwise prepared in laboratories than by the decomposition of red oxide of mercury. The use of a more common oxide, the peroxide of manganese, $MnO_2$, treated either directly by heat or with the co-operation of sulphuric acid, was at once an important practical improvement; but the very great impurity of the gas thus made, and the need of a strong furnace for heating, made these methods somewhat impracticable for the laboratory, and they have been advantageously replaced by the more convenient and more successful method which is there still in use, namely, the decomposition of chlorate of potash by heat.

For several years past oxygen has been prepared in experimental laboratories on a rather large scale; its consumption amounts to hundreds of litres, for the production both of high temperatures, by the blowpipe, and of that brilliant light to which Drummond has attached his name, and which seems to be destined at the present time to assume a really practical importance. It is no longer a problem to heat a few grammes of chlorate of potash in a glass retort; but, without changing the purity of the product, a method of heating has been arranged of a still more practical character. A mixture of chlorate of potash, well powdered, and of peroxide of manganese, is put into an iron bottle (such, for example, as serves for the transport in commerce of mercury); the peroxide of manganese, added in the proportion of 1·10, acts chiefly mechanically in preventing the fusion to a *frittc* of the material, for the temperature at which oxide of manganese alone is decomposed is not attained. This bottle is closed by means of a bent iron tube, into which is fitted a cork with a glass tube which communicates, by means of a caoutchouc tube, with the recipient of the gas. There is no more recourse to the old-fashioned gasometer, except in special cases, but, for all ordinary applications, air-tight bags of vulcanised caoutchouc cloth are used; the gas under pressure may be kept in these for years, provided that it has been washed before its introduction: it will be evident that it could not be so if the oxygen contained still any chlorine, even in small proportion. Operating in this manner, between one and two cubic metres of oxygen are obtained in about two hours, if the iron bottle is heated in a portable furnace with charcoal mixed with coke; it is sufficient to make the gas rapidly pass through a basin filled with water before storing it up in the bags. But now, what is the cost price? Chlorate of potash costs, on the average, 4fr. 50c. the kilogramme (in France), somewhat less, wholesale, in England; so that the price of the cubic metre of oxygen will amount to 16frs., without including the expense for heating, and attendant labour, which will raise it altogether to possibly 20frs. At these prices the direct use of this agent for combustion for any manufacturing purpose is almost impossible.

M. Boussingault is the first chemist who thought of producing oxygen on a large scale, by availing himself of a very curious property which he had discovered in barytes. That oxide, the protoxide of barium, possesses the peculiarity of combining, when in its state of most absolute causticity, directly with the oxygen of the atmosphere at the temperature of obscure redness in daylight, changing into binoxide of barium; if this new oxide is now brought up to the heat of *bright redness*, it again disengages all the oxygen it previously absorbed. The barytes is placed for this operation in a porcelain tube, which is heated to the proper temperature, and into which is passed a current of damp air. As soon as the absorption of the oxygen ceases to take place, the binoxide produced is put into an earthenware retort and heated to bright redness, and so it again gives up the oxygen it had derived from the air.

The barytes thus renewed may serve for one repetition of the operation; but it is afterwards powerless: it must be revived by nitric acid, which requires a tedious and expensive operation. One kilogramme of barytes gives thus 73 litres of oxygen, or, in practice, about 15 gallons to the pound weight. If the revivification of the barytes had not been necessary, M. Boussingault would have discovered in that body a veritable chemical sponge to draw oxygen from the atmosphere. For some years, however, this ingenious combination is only referred to as part of the history of the subject. Quite lately, M. Gondolo, an engineering chemist, has been successful in modifying the method of M. Boussingault, so as to make it fully available in practice. The barytes is mixed with mineral alkali; it is thus prevented from fritting together, and it maintains its porous character, which enables it constantly to absorb oxygen. This mixture is no longer heated in porcelain tubes, but in tubes of iron, and by means of a furnace, the temperature of which can be easily regulated, so as to produce either the low heat needed for the absorption of oxygen, or the higher one, for its release. In a single half-hour several cubic metres of oxygen can be obtained, and the alternate oxidation and deoxidation of the barytes can thus be repeated even one hundred times. It is obvious that the oxygen thus obtained will cost but very little. M. Gondolo, however, collects also the nitrogen, which is a necessary educt, from the deoxigenation of the atmospheric air. He thinks that it can be profitably employed for many purposes, as for filling the air-tight cases for alimentary preserves, and for the manufacture of manures, and for the preparation of various chemical products.

MM. H. Deville and Debray indicated some years ago the possibility of reducing sulphuric acid, by heat alone, to sulphurous acid and to oxygen, by letting fall that acid drop by drop upon a plate of incandescent platina. One kilogramme of sulphuric acid will thus afford seven cubic metres of gas, at a price of one franc the cubic metre. But this method, although interesting from a scientific point of view, has not been found to succeed in practice.

The system of furnace with concentric envelopes, invented by M. Archereau, which may really be called a "*trap*" for heat, has admitted of another cheap method of making oxygen. The heat produced by the fuel is absorbed by a layer of bricks; and by an ingenious combination, like that of the regenerative furnace, it is completely restored to the chamber where reaction has to be produced. The high temperature thus procurable, and steadily sustainable for the necessary time, enables us to effectuate the known reaction of silica on sulphate of lime, which produces silicate of

lime, sulphurous acid, and oxygen. This can be performed in an uninterrupted and advantageous manner. The reaction is given by the equation—

$$SiO^3+CaO.SO^3=CaO.Sio^3+SO^2+O.$$

The gaseous mixture is passed into a condenser, where it is submitted to a pressure of three atmospheres; the sulphurous acid liquefies, and the released oxygen freed from it passes through a vessel of lime-water, where it is completely purified from remains of sulphur acids. It is then stored up under pressure in metallic reservoirs. The sulphurous acid might afterwards be transformed back into sulphuric acid by the usual process. The author assures us that each cubic metre of oxygen prepared by this method will cost but 50 centimes, and that the oxygen-gas will be delivered at private houses in Paris for about 1 franc 25 centimes. Here we arrive then at the pecuniary conditions at which oxygen may boldly claim to have an industrial career.

M. Mallet observed in the same year that the protochloride of copper, $Cu^2Cl$, absorbs oxygen from the atmosphere, and becomes an oxychloride, $CuCl.CuO$, capable upon being heated to 400° Cent. to restore again that oxygen, so as to become once more $Cu^2Cl$, and that indefinitely. This chloride then is mixed with some inert matter (sand, or kaolin), in order to prevent its fusion when heated, and the mixture is placed in cylindrical iron retorts, which rotate slowly upon their horizontal axes: both the evolution and the revivification by absorption take place in these retorts. A very short time since the inventor improved his process, which was exhibited at Paris in 1867. He has found it sufficient to raise the chloride of copper to 150° Cent. to cause it very rapidly to absorb back the oxygen of the atmosphere: this absorption is at that temperature almost instantaneous. It is thus evident how much the operation is facilitated. With 100 kilogrammes of protochloride of copper, 15 to 18 cubic metres of oxygen are obtained at a cost of 60 centimes the cubic metre. The inventor has not stated how often the protochloride can thus be alternately used for the absorption and evolution of oxygen; but there does not appear to be any obvious limit.

Lastly, MM. Tessié du Motay and Maréchal have found a constant source of oxygen by calling to mind certain very curious chemical reactions, and by combining them in a very ingenious manner. The alkaline salts of acids with metallic bases (such as permanganates or ferrates of potass or of soda &c.) are decomposed by vapour of water when they are heated to a sufficiently high temperature, and then evolve oxygen. Once thus deoxigenated, these salts possess also the peculiarity of reoxigenation when exposed to a current of atmospheric air of an equally high temperature. This is again the extraction of the oxygen of the air under the action of heat. Oxygen has been prepared by this process in large volumes at the Hôtel de Ville in Paris, and employed for the efficient and conclusive experiments on the great scale made there and at the Tuileries, under the command of the Emperor, for rendering public illumination by the oxy-hydrogen-gas and zirconium (or lime) light practicable.

Early in the spring of last year, when M. Tessié du Motay explained at the Hôtel de Ville his mode of operating with the apparatus before him, his manganate had then already served two months, and his assurance was that it would continue to do so for a long time further. Fifty kilogrammes of manganate of soda produced then, after two months' use, between 400 and 450 litres of oxygen, and after 80 successive reactions. The atmospheric air, however, must be purified as much as possible from carbonic acid. The cost price of oxygen thus obtained at Paris is 72 centimes the cubic metre, but at Metz only 50 centimes; it varies according to the cost of coal and labour in different localities.

MM. Tessié du Motay and Maréchal have established a factory at Pantin, near Paris, where they manufacture oxygen, which they deliver at Paris in circular iron gas-holders, similar to those for the so-called portable coal-gas. They intend also at the same time to prepare pure hydrogen, which they require for their methods of illumination. A great revolution has thus taken place in the scientific history of oxygen in the course of the last few years; for the gas, which used to cost 20 francs the cubic metre, and which was sold at about 35 francs the cubic metre for the occasional scenic lighting of the theatres and for public festive occasions, can readily be now obtained at the works at the average price of 80 centimes the cubic metre, and is delivered for 1 franc 50 or 1 franc 75, according to distance.

Let us now examine some of the industrial causes which have determined this actual and economical manufacture of oxygen; a real manufacture, for although the industry of oxygen may remain for some time in its embryonic state, its production as an article of commerce will form a great event in our scientific annals, and mark an epoch hereafter as regards many branches of manufacture and of metallurgy.

What, then, may be the industrial part that oxygen is destined to play? Not more than ten years ago M. Malaguti, in his excellent *Traité de Chemie*, in the chapter entitled "Applications of Oxygen," wrote as follows:—"Oxygen has up to the present time received no applications. . . . To obtain oxygen at a reasonable price, and to condense it for the requirements of industry, would be a grand problem worthy of solution. Heat is one of the most important instruments in the hands of the manufacturer. This instrument is the more useful the more energetic the heat: the blowing-engine alone is sufficient evidence of that. That apparatus condenses, however, not alone the oxygen, but with it is also condensed an inert gas, which absorbs uselessly a portion of the heat of combustion." This problem then, so important for chemistry in all its applications, as well as for many arts, has been already solved by science, and it is now the part of industry to turn the solution to profit. We must remark in passing, however, that Malaguti was here scarcely historically correct; we quote from memory only, but believe we are correct in saying that Wedgewood in England and Achard in France both endeavoured to apply oxygen, in place of atmospheric air, to the blast of small blast-furnaces, with, however, little other result than that of melting down their furnaces.

Since the time chemists have studied the properties of oxygen and of hydrogen, they have fixed their attention upon the enormous calorific power of the flame which the mixture of hydrogen and oxygen in the proportion of 1 to 2 produces. Several instruments or blowpipes have been contrived for burning this detonating mixture without danger, but this calorific instrument remained until the present time very little used, and solely by the scientific man. M. H. Deville, at the period of his fine researches on the working of platina, showed of what great importance the gas blowpipe might become to metallurgic industry requiring high temperatures. The oxy-hydrogen flame alone is capable of melting platina in large quantities by the method of MM. H. Deville and Debray. These chemists ask, will it not be simpler in the manufacture of iron, instead of first bringing together laboriously sundry pieces of iron by means of puddling and then of trying to weld them by the coarse process of hammering, continuing the forging for a length of time, to melt the iron together at once? That they imagine would only be possible under the condition that the furnace be supplied with pure oxygen. We might then have, melted wrought-iron, flexible, malleable, possessing great tenacity, and at the same time with almost the softness of the lead. There may be, indeed is, in this a great deal that is chimerical and, as respects manufacturing realities, even incorrect. And there is no doubt much in what follows as to which the same might be said; yet there is a vein of prophecy of future progress when they also tell us that the most refractory minerals might be melted in a few seconds in small furnaces fed with oxygen, instead of in a blast-furnace of 15 metres in height taking in a gas which contains an inert body to the extent of $\frac{4}{5}$ of its volume. Might not thus these huge blowing-engines, which waste so great a power in delivering these torrents of air, be omitted with great advantage both for convenience and economy? Why shall this powerful calorific agent not be now utilised in a continual manner in our large laboratories, where all other progress in science has been practically realised? What is simpler and less expensive than to condense the oxygen, prepared by one or other of the methods already described, into a large gas-holder, and to lay it on in the easiest way to different parts of the laboratory where the blowpipes and furnaces, of which simple and convenient model forms exist already, could be established either fixed or movable? What they here say about the "large laboratories" refers equally to our metallurgic and other workshops, where metals, alloys, porcelains, glass &c. have to be operated upon. A saving of workmen's labour and time will really accrue by suppressing these huge coke-fed

furnaces and by using their energetic heat, which can be roused or modulated or extinguished by the action of two cocks. A gas-holder of small volume will easily contain ten cubic metres of oxygen gas, condensed under a pressure of two or three atmospheres.

In all this there is much that is true, but also a good deal that, at present at least, is merely visionary. Heat, indeed, we can thus have, and concentrated to any extent, but the difficulty arises (as yet) how we are to apply it. The most refractory materials of which hitherto we have been able to construct our furnaces won't stand against it. We melt the furnace almost as quickly as whatever may be in it. Lime crucibles, as used by Deville, may do for some purposes and in his hands, but (as yet) are not fitted to the manufactory.

*(To be continued.)*

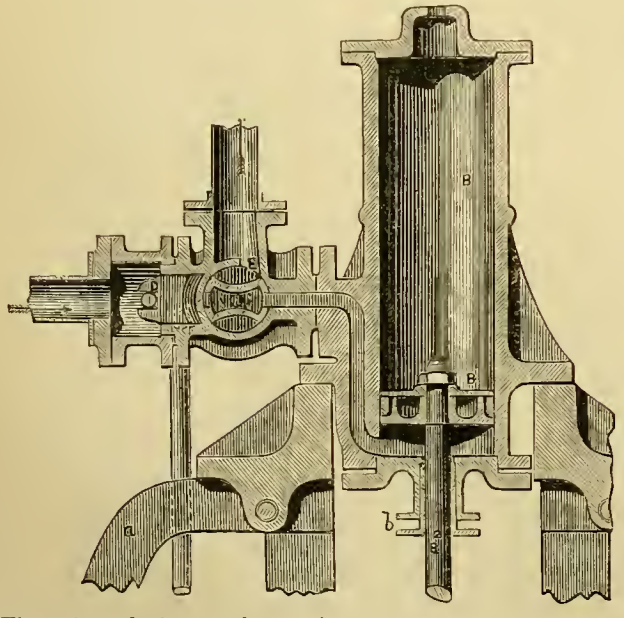
## THE BUDENBERG STEAM-HAMMER.

*(Illustrated by Plate* XII.)

THE improved steam-hammer represented in our plate engraving for this month, and in the accompanying wood engravings, is the subject of letters-patent granted a short time since to Mr. Arnold Budenberg (of the firm of Schäffer and Budenberg, of Manchester), as a communication from Mr. Carl Mund of Magdeburgh, Prussia. It had long been a *desideratum* in the working of steam-hammers to avoid injury to the piston and piston-rod by the violent vibration or concussion produced at the instant of the hammer head effecting its blow; and it was with this object in view that the arrangements about to be described were devised.

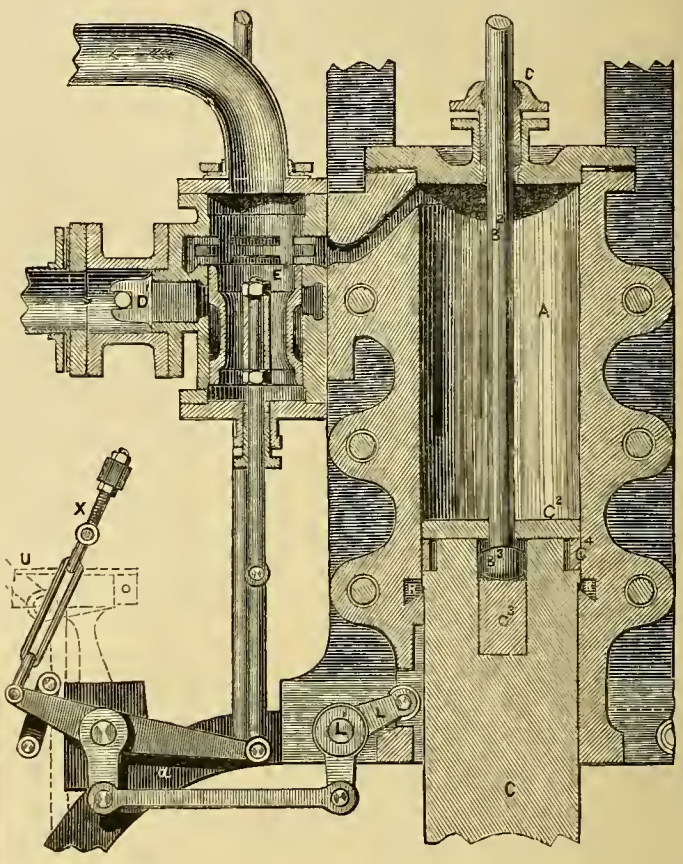
For this purpose, whilst the steam acts in a cylinder direct on the ram or plunger, forming the striking weight to which the hammer head or striking face is attached for effecting the blow, the ram, with the hammer head or face, is lifted by the steam acting on a piston in a separate cylinder, and the piston-rod of this piston is connected to the ram by a kind of ball joint, or joint admitting of play. India-rubber, or other elastic substance, is applied in the connecting parts to reduce the force of the shock. The end of the ram acted on by the steam is made tight by packing or otherwise; and the passages for the steam to act on the ram or plunger for the blow, and on the piston for the lift, are connected by lever and links to be worked together. The invention will be clearly understood on reference to the plate and wood engravings, to the latter of which only we have attached letters of reference.

Fig. 1.




Figs. 1 and 2 are front views in section, showing the cylinders A and B, carried by the main framing of the hammer, the cylinder A being adapted to receive the ram or plunger C carrying the striking-weight or hammer $C^1$, whilst the cylinder B is fitted with a piston $B^1$, the piston-rod $B^2$ of which passes down through the stuffing-boxes *b* and *c* to the ram or plunger C, to which it is connected, the connection of the rod $B^2$ with the ram or plunger being obtained by that rod having an enlargement $B^3$ formed on its lower end, which enlargement is received into a suitable recess formed for it, as shown in the plunger C, and in which it is held by means of the plate $C^2$, which is formed with a hole for the passage and play of the rod $B^2$, an arrangement which admits of play to the parts, if needed, similar

Fig. 2.




to that of a ball-joint. India-rubber or other elastic packing $C^3$ is applied under the enlargement $B^3$ in the recess formed for it in the plunger C, to receive the thrust of the piston-rod and avoid injury to the piston or piston-rod from the violent vibration or concussion produced when the hammer head is effecting its blow; the plunger C is prevented from turning in the cylinder A by guides. The upper part of the rim or plunger is made steam-tight by means of suitable packing $C^4$, or otherwise. Supposing the hammer head is at rest on the anvil-block, and that the admission-slide D of the small cylinder B is open, so that steam may enter under the small piston $B^1$, to lift the ram or plunger C; that plunger in rising will bring the projection $C^5$ on the ram C in contact with a truck or bowl carried by one end of the lever L, and by causing that lever to turn on its axis $L^1$, effect the reversal of the position of the levers and parts acted thereon, so that the steam which had passed on to the under side of the piston $B^1$ may now escape into the atmosphere, and steam will then pass into the cylinder A by the valves $D^1$, $E^1$, to act on the upper side of the piston or plunger, according to the strength of blow required. After the blow the levers are brought back to their original position by the spring X; or if the hammer should not be required to work self-acting, a lever or other handle may be used instead of the spring. The break U is applied for regulating the blow of the hammer. A groove R is provided in the cylinder A for receiving the water accumulating by the condensation of the steam and the discharge of it into the open air. The ram for this purpose is recessed, as shown at a proper distance from the packing-rings $C^4$.

Another arrangement of valves and parts connected therewith is shown in figs. 3 and 4 of the engravings, consisting in a discharge or equilibrium slide-valve applicable particularly for steam hammers of large size. The slide A¹ is connected by means of the screw-bolt C, and the nuts E and F with the plate B in such manner that the distance between A¹ and B can be altered by the nuts. The interior of the slide A¹ communicates with the atmosphere by means of the opening O of the cover of the encased slide-valve. The atmosphere likewise enters into the interior or space formed by the plate B, the spring-plate G, and the slide A by an opening which is bored lengthways through the screw-bolt C. The above-mentioned pieces form in their combination the slide-valve. The two frames S and S¹ are connected to the sliding-rods, which are connected together by the bar T; the slides A and A¹ are pressed against the faces on which they slide by the pressure of the condensing steam or gases, and also by the atmospheric pressure which exists in the interior of the casing formed by the parts A, B, and G, but this pressure is counteracted by the pressure which exists on the hollow sides of the slides. The dimensions of the surfaces on which the pressure acts can be so regulated that the pressure is entirely counterbalanced on both sides of the slides, or an excess of pressure may be created on either side of the slides. The distinction in this principle of action over other equilibrium valves

Fig. 3.

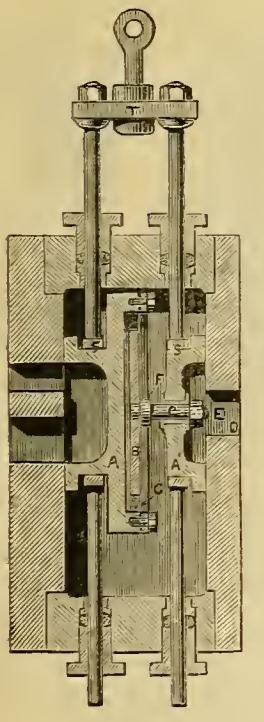
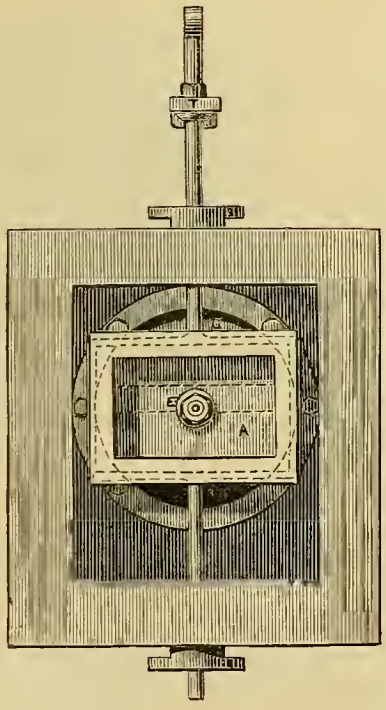


Fig. 4.



consists in the arrangement by which the plate G admits of deflection between the slides and their faces. The nut F is arranged to be operated upon from the outside by a screw-key. Although the slides A and A¹ are moveable against each other by the spring-plate, this movement does not take place during the sliding motion of the valve if the sliding surfaces are parallel to each other. The interior of the casing A, B, and G, might be closed entirely and arranged to contain air of a certain pressure, and the opening O also dispensed with; but the arrangement as above described is applied by preference, as it allows of controlling the perfect closing of the slide A¹ and the regulation of the nuts E and F without opening the casing of the sliding valve.

[The essential difference between this steam-hammer and others is, that in Mund's or Budenberg's the piston-rod is mainly exposed to "work" in one direction only, and that one producing tension only; and the merit claimed for the arrangement is, that thus the piston-rod, and especially the head of same where in connection with the hammer itself, is less exposed to that jarring and percussion which tends soon to make it break short off, as has been the general experience with hammers of the Nasmyth and other similar constructions.

This claim is no doubt in a considerable degree realised, yet not fully, for it must be evident that the piston-rod is still exposed to some jar by its own inertia and that of the upper or lifting piston at the instant the blow is made. This jar is, however, beyond question much mitigated by the effect of the cushion of steam below the piston at the bottom of the top cylinder at the above-named instant, and by the elastic packing below the piston-rod head at the hammer. As a *per contra* we have some slight disadvantage, due to the difficulty always found in keeping three rigidly fixed points in a line—*viz.* the top piston and two stuffing-boxes, all to be kept steam-tight. Then there is certainly a certain economy of heat and steam in lifting the hammer by a small and *merely* sufficient top cylinder, and driving it down to give its blow by the larger and more powerful one applied directly upon the top of the hammer-head. Might it not, however, be a still greater economy to take the steam from the latter cylinder and condense it and *lift* the hammer by the vacuum so produced in place of blowing-off to waste, merely dense steam from both?

One element of constructional economy is secured in this hammer—*viz.* the power of making the hammer-head, or lower piston-plug, merely of cast-iron. In this respect these hammers have an advantage over the Morrison hammer.

As regards the security of the piston-rod, it must not be forgotten that years ago James Nasmyth himself interposed elastic packing between his piston-rod and hammer-head, and made the end of the piston-rod a sort of rude ball-and-socket joint, to ease lateral jarring. After all, jarring or vibration—that mighty unknown bugbear—does no harm whatever to metals where the "work" to which they are exposed is kept pretty largely within their elastic limits—*i. e.* the limits of their permanent deformation, and where the velocity of the impact producing vibration is moderate. The former condition we can always secure by enlarging the area of impact so as to procure a small maximum of pressure per unit of surface, and the latter need never be excessive, if the hammer-head be kept heavy enough in relation to the task it is called upon to perform.

This being so, we confess we are not prepared greatly to prefer these hammers to those of the Morrison construction, where the piston-rod itself, enlarged to the diameter of a heavy column of iron or steel, gives the momentum to the blow, and is lifted, as well as impelled, by a piston embracing the middle of its length.]—Ed.

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## RECENT PATENTS.

### ARTIFICIAL STONE BLOCKS.

John Henry Johnson, 47 *Lincoln's Inn Fields*; *a Communication from* François Coignet, *Paris. Patent dated March* 23, 1869.

This invention relates to improvements in the artificial stone blocks known as "Béton Agglomeré," and consists in facing those parts of such blocks as are most liable to become worn or injured when in use with cast-iron or steel protecting-plates. The protecting-plates are secured to the blocks either by claw-bolts secured to or cast in the plate, and embedded in the substance of the block at the time of running the materials into the mould, or by bolts and nuts.

It is proposed to employ these protective blocks as street kerbs, steps, and other parts of buildings, and flags, in which case the corner or angle or other surface most exposed to hard wear is protected by an angle-piece of steel or cast-iron. The shape of the protecting-piece may be varied according to requirement. It is also proposed to use thin artificial blocks, provided with protruding plates on their surfaces, having either a raised rib or sunk groove on their surfaces, to serve as wheel-tracks for ordinary vehicles, or for the wheels of street railway carriages. Fig. 1 of the accompanying engravings shows the mode of applying this invention to kerb-stones. The outer corner, which is most exposed to the action of

Fig. 1.

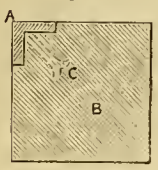
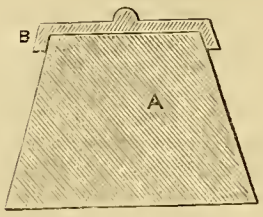
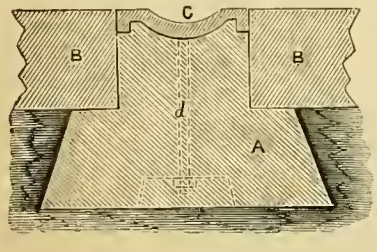



Fig. 2.




the vehicles, is covered with a plating of cast-iron or steel, which is secured to the artificial stone blocks by metal holdfasts, around which the beton is carefully agglomerated, so that these holdfasts cannot be withdrawn without breaking the block. When bolts, passing through the blocks, and nuts are substituted for the holdfasts, perforations are left at the time of moulding for the reception of the bolts. A is the metal plating, B the block of beton, and C the holdfasts. Fig 2 is a cross section of the beton block or sleeper A, as arranged for tramways, the surface of the block being covered with a plate of metal B, provided with a centre rib, and with small flanges to protect the corner of the stone. Fig. 3 shows an arrangement which may be adopted with advantage for tramways. In this case, in lieu of stones or blocks of a prismatic form, there are employed blocks the arrangement of which admits of one or two rows of paving-stones being inserted, which protect the plated sleeper from being injured by the macadam, and from the various defects which generally result from the difference in level of the sleeper and macadamised road, which is necessarily produced in the course of time by the passing through the passage of vehicles. Bolts *d d* blocks of beton, with countersunk heads, may also be employed in this arrangement, to secure the combined plating and rail C thereto. The paving-stones B rest on the block A in the recesses formed for that purpose; which stones serve as an intermedium between the macadam and the rail, to prevent the action of the wheels of vehicles and render repairs almost unnecessary.

Fig. 3.

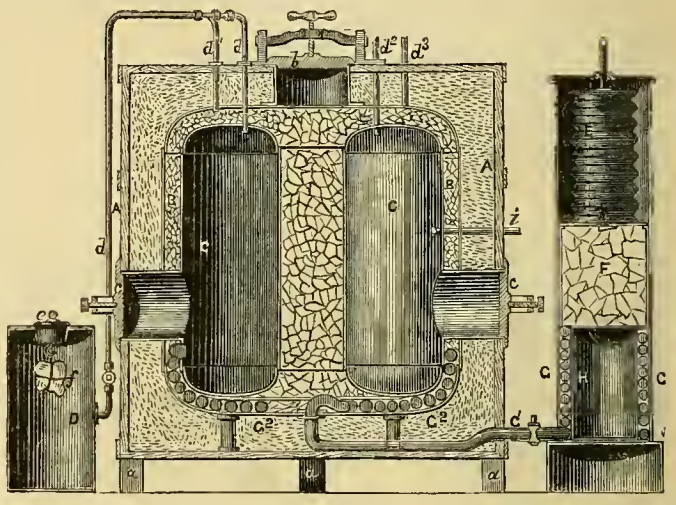



## PRESERVATION AND DISINFECTION OF ANIMAL AND OTHER SUBSTANCES.

Louis Napoleon Legras, *London.—Patent dated February* 16, 1869.

This invention relates, firstly, to a method of preserving animal and other substances, but is more particularly applicable to the preservation of meat in a fresh and natural state during long voyages, or extended periods of time. Secondly, to the disinfecting and purifying of animal and other substances.

The accompanying engraving is a sectional elevation of the apparatus employed in carrying out the invention. It consists of three chambers or reservoirs, A, B, and C, formed of iron or other suitable metal or material, and of any convenient form, placed one inside another. The outer chamber A may be made of wood, and is supported upon feet *a* to raise it from the ground; it is to be filled with any good non-conductor of heat, such as felt, powdered charcoal, or carbonised saw-dust. The next inner compartment B is to be filled or partially filled with ice, or other refrigerating substance or substances, whilst the third compartment or chamber C serves to contain the meat or other substances to be preserved. The chambers B and C are provided with air-tight felting manhole lids *b* and *c*, respectively, for the introduction of the ice or refrigerating substance, and for the introduction and removal of the substances to be preserved. The compartment C, shown of an annular form, must be made air-tight, and a vacuum or partial vacuum is to be produced therein by means of a closed chamber or vessel D connected by a pipe *d* with the compartment C, and provided with means for enabling the air therein to be readily consumed or burned when required. With this object a tight-fitting stopper *e* fits into an opening in the vessel D, and carries a sponge *f*; which sponge, when a vacuum is to be produced, is to be dipped into spirits of wine, or other similar inflammable liquid, and ignited, and inserted in its ignited state into the interior of the vacuum-producing vessel D, the plug or stopper *e* preventing the inlet of further air. The air in the vessel D is thus consumed; and so soon as the vessel has become cool again, the air contained in the preserving chamber (and, if desired, that contained in the air-chamber B) rushes in to the vacuum-vessel D, through the pipes *d* and *d'* respectively, thus producing a partial




vacuum in the chambers B and C. The communicating pipes *d d'* are provided with stop-cocks. The partial vacuum thus produced in the preserving chamber or compartment C is rendered more complete by placing in such compartment or chamber salts of calcium contained in suitable receptacles, which salts absorb both air and moisture. By maintaining the vacuum and the supply of calcium and of ice or refrigerating substance, the inventor has found that animal and other substances may be preserved for several months in a sound and natural state. He sometimes, if the substance to be preserved be not quite fresh and pure, at intervals introduces dry cold air into and amongst the substances in the chamber, for the purpose of drying and freshening the same. For this purpose he employs an air-forcing apparatus consisting of a bellows E (for example), the outlet-opening *h* of which communicates with a chamber F which is filled, or partially filled, with pulverized charcoal mixed with a little sulphate of calcium, and a very small quantity of chloride of calcium.

This chamber communicates again with a coil G kept cold by placing ice or other refrigerating substances in the central chamber H, round which such coil passes. The coil G is connected by the pipe $G^1$ (provided with a stop-cock), with a second coil $G^2$ placed in the bottom of the ice-chamber B, and opening into the preserving-chamber C. On working the bellows, air will be forced through the chamber F, and will be dried and purified by passing through the substances contained therein, and cooled on its passage through the coils G $G^2$ to the chamber C. In addition to this, he sometimes introduces a portion of the mixture of pulverized charcoal and calcium into a closed bottle or vessel, which is connected by a pipe *i*

with the preserving-chamber C; and he pours a little sulphuric acid on to the said mixture in the bottle or vessel, whereby sulphurous acid gas is generated, which enters freely into the chamber C, a cock on the pipe *i* being opened for that purpose, whilst another cock in the opening through which the mixture and the sulphuric acid are introduced into the bottle, is closed, to prevent loss or escape of the gas through such opening. After this gas has been allowed to act upon the contents of the chamber C for a few minutes, the vacuum is reproduced. Suitable openings, capable of being closed air-tight, are provided on the top of the apparatus for the introduction of thermometers and vacuum-gauges, when required. The second part of the invention, which relates to disinfecting, consists in placing in the vessel or receptacle containing the substance to be disinfected (or in the substance itself), if it be fluid, or of a plastic or soft nature, potatoes which have been subjected to a steaming process, sufficient to cook the same. The action of the potatoes so prepared is to take up or absorb all the unpleasant or rank odour and flavour from the surrounding substances, leaving them sweet and pure.

## SHAPING AND FINISHING ARTICLES.

BERNARD PEARD WALKER, *Wolverhampton.—Patent dated February 25, 1869.*

THIS invention relates to the manufacture of a variety of articles in which the process of grinding and polishing is employed for the purpose of shaping or finishing their surfaces, and consists, partly, in the adaptation of the copying principle employed in the machines in use for the shaping of the wood stocks of guns, lasts for shoes, and such like articles, to the production of surfaces other than flat, in articles of metal, and partly in special machinery and apparatus for grinding and polishing the edges and surfaces of the metal heels of boots and shoes, the edges of iron washers for machinery, and similar articles. The invention may be briefly stated to consist in the three following principal features, viz. :—First, a system or mode of grinding or polishing metallic articles by the aid of a model or "shaper plate" operating as hereafter described; second, in a system or mode of grinding or polishing the edges or surfaces of heel tips, washers, and similar articles, by causing them to revolve or change their position by the aid of a rotatory spindle and rollers whilst in contact with the grinding surface; third, in the use of a rotatory spindle carried in a vibrating frame or slide, and capable of moving to and from the grinding or polishing surface, for the purpose of presenting different parts of the article to be ground to the action of the grinding or polishing surface.

Fig. 1.

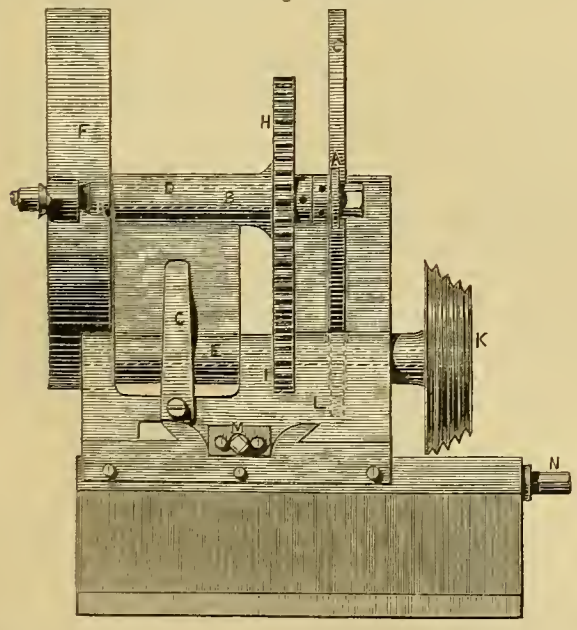
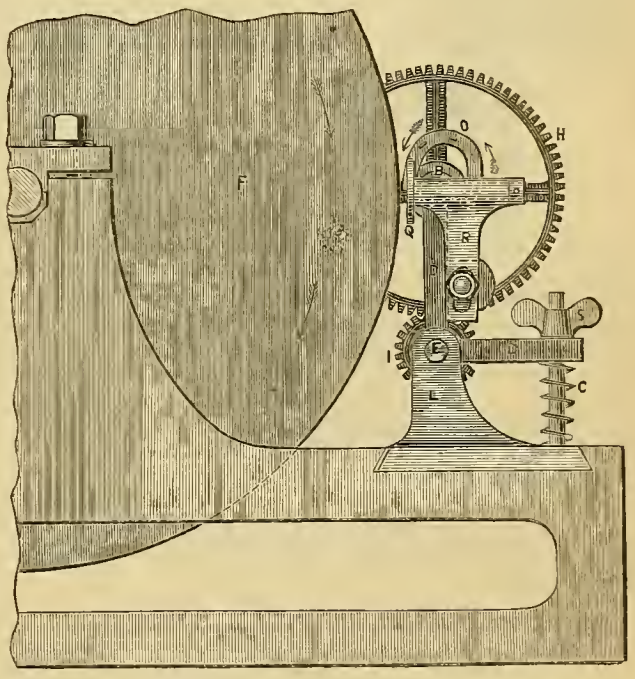



Fig. 1 of the engravings represents a front elevation of the improved machine for grinding articles by the aid of a model or "shaper plate," and shows its application to the grinding or polishing of the sides of hexagonal nuts. A is a steel model or "shaper plate" of the form and size of the finished article required. This model is fixed to a spindle B so as to turn with it, and rests against the surface of a metal disc or roller C, which should be nearly of the size and shape of the grinding wheel employed in the process. The article to be shaped (in this case a hexagon nut) is attached to the opposite end of the spindle B, so that it may revolve along with the model A. The spindle B is mounted upon a vibrating plate D, which is furnished with a pivot E, upon which it vibrates towards and from the surface of the grinding wheel F and disc C. The model is by means of the blade-spring G kept in close contact with the edge of the disc C. By means of the wheel H and pinion I, driven by the pulley K, the spindle B is made to revolve. The axis of the shaft of the pinion I is in the same line as that of the pivot E of the vibrating plate D, so that the revolutions of the spindle B are not interrupted by the vibrations of the plate D, which, as will be evident, must take place when the spindle is rotated. The

Fig. 2.

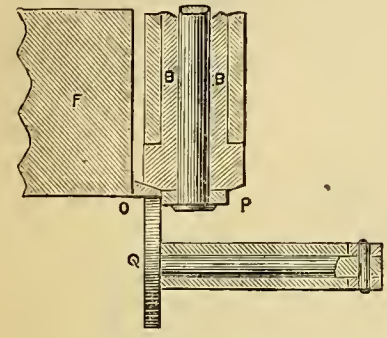



shaft of the pinion I, the pivot of the vibrating plate D, and the support of the plate C, are all attached to one casting L, which is mounted in the same way as the top of an ordinary slide-rest of a lathe, so that by the action of the screw spindles M and N of the cross slides the position of the spindle B, and consequently of the article to be shaped, can be varied at pleasure, either towards or from, or along the surface of the grinding wheel. The grinding wheel F, which may be of any abrasive material, is mounted in the ordinary way, and may have an endlong motion given to its spindle, so as to traverse slowly to and fro, and thereby wear its surface evenly; or the work may be brought in contact with successive portions of the grinding surface by means of the cross slides above referred to, upon which the carriage plate or casting L is mounted.

Fig. 2 is an end elevation of one of these machines, adapted to the finishing and polishing of the edges or surfaces of shoe heel-tips, by means of a grinding wheel, which may be either a natural grindstone, an emery wheel, or other suitable revolving grinder. A portion of such a wheel is shown at F, with appropriate spindle and bearings. B is a revolving spindle, so arranged as to be driven continuously by either toothed gearing or belt, or gut, whilst its distance from the grinding surface is varied. This spindle is furnished with chucks, or other contrivances, by means of which the article to be operated upon is secured thereto, so that by its revolution each portion of the surface is successively presented to the

grinder. In this modification of the machine the spindle B is mounted on a vibrating frame D, which frame moves on a pivot or axis E in a line with the axis of the pinion I. The pulley K, by means of which the pinion I is driven, is, like it, keyed upon its axis, and by its revolution drives the wheel H into which the pinion I gears. Motion is imparted to the pulley K from the prime mover by any suitable means. The patentee prefers to make this pulley with grooves of different diameters, so as to be able to suit the speed of the spindle B to the work required to be produced and the variation of the abrasive power of the grinder. O represents a heel-tip, the edge of which is to be polished. The end of the spindle B is formed into a roller at the point where the tip is applied (see fig. 3), and a cushion of elastic material P, such as leather or vulcanised india-rubber, is arranged to form part of the said roller. This elastic cushion or washer is secured to the spindle B, and made to revolve with it by means of a screw bolt passing through the length of the spindle and furnished with a nut.

Fig. 3.




O (fig. 3) is a section of the iron of which the heel-tip is made, or a section of one side of the heel-tip; Q is a roller mounted on a spring-arm R (fig. 2), and so adjusted as to press the heel-tip into contact with the roller end of the spindle B. It will be evident that when the spindle B is set in motion the heel-tip will be drawn in between the two rollers Q and B in the direction indicated by the arrows (see fig. 2), and carried round by them, whilst the edge of the heel-tip will by the cushion or washer P be kept in yielding-contact with the surface of the grinding wheel. The distance of the rollers from the surface of the grinding wheel is varied to suit the different sections of the heel-tips by means of the fly-nut and screw-pin S, the spiral spring G keeping the horizontal part of the vibrating frame D in contact with the fly-nut, and also allowing the frame to move away from the grinding-wheel should any irregularity in the surface of the latter or of the heel-tip which is being ground or polished require it.

## LAW REPORTS.

SEWING MACHINES.—THE WHEELER AND WILSON MANUFACTURING COMPANY *v.* SHAKESPEAR.—Before Vice-Chancellor Sir W. James. November 10, 1869. Mr. Kay, Q.C., and Mr. Speed were for the plaintiffs; and Mr. Bristow, Q.C., and Mr. Beale for the defendant.

The plaintiffs, who are a body politic and corporate, originally incorporated in 1854, under a general law of the State of Connecticut, for the purpose of manufacturing sewing machines, complained by this Bill that the defendant, a Mr. Thomas Shakespear, who has a depôt for the sale of sewing machines at No. 32 Union Street, Birmingham, and who has been an agent of the plaintiffs, and had been dismissed by them, had been falsely giving himself out as being still their agent, and selling certain machines as Wheeler and Wilson's, which were not in fact the plaintiffs' machines, nor constructed according to their make, and prayed for an injunction accordingly.

The defence was substantially this—that Mr. Shakespear never did represent himself as the agent of the plaintiffs, though he admitted he did designedly represent himself as the "agent of their machines;" and further, that "Wheeler and Wilson" has become to be a technical term, universally known in the trade to represent a particular sort of machine.

The Vice-Chancellor said he could not give the plaintiffs quite all the relief they asked, inasmuch as he considered the words "Wheeler and Wilson" as having come to be the name of a sewing machine of particular make. It was easy to understand that there being no other designation of the machine than the names of the patentees, those names had come to signify every article made according to the plan described in the specification; and the patentees could not claim a trade mark in such names. But as to the rest, it appeared that the defendant had been an agent of the plaintiffs, had been advertised as such, and the plaintiffs had warranted goods sold by him. After that they were minded to deprive him of the agency; but he, nevertheless, in a series of advertisements continued to describe himself as holding the same connection with the plaintiffs as he did before. This was no doubt a gross fraud on the plaintiffs, and it was impossible to estimate the amount of injury which a trader might sustain through the false representation by another that he was an agent of the trader when he was not. The advertisements issued by the defendant were such as in the view of the court were calculated to mislead the public and injure the plaintiffs, and there must be an injunction substantially as prayed, the defendant to pay the costs of the suit.

SKIDS.—POUPARD *v.* FARDELL.—Court of Chancery; before Vice-Chancellor Sir R. Malins, November 17, 1869. Mr. Glasse and Mr. Bovill appeared for the plaintiff; and Mr. Mackeson, Mr. Stevens, and Mr. W. W. Cooper for the defendant.

This suit, which occupied nearly six days in the hearing, was instituted for the purpose of restraining the defendant from making skids according to a pattern which was the subject of a patent taken out by the plaintiff in January, 1859. The plaintiff was a scale and machine maker in the Blackfriars, and the defendant a carman in a large way of business in the neighbourhood of the docks. The invention claimed consisted in the construction of a skid, or shoe, for the skidding of wheels in descending inclines, with a tail-piece projecting from the back part of the top of the skid chamber, and the inventor in his specification said, "the tail-piece may be carried entirely through to the front of the shoe. I prefer to form it of wrought iron or steel, while the body of the shoe may be of cast or wrought iron. The best results to be obtained when the projecting tail-piece is curved upwards, but I do not limit myself to so shaping it." The defence was—first, want of novelty, in support of which evidence was brought forward to show that the principle of the plaintiff's skid had been in use twenty years ago, and had been adopted in the service drag-shoe of the Royal Artillery; and, secondly, that the specification was insufficient, inasmuch as it stated that the plaintiff did not limit himself to forming the projecting piece with an upward curve, though, as the defendant alleged, that was the only form in which the invention was valuable for its purpose of facilitating the entrance of the wheel into the skid chamber.

On the part of the plaintiff, Colonel Philpot, Serjeant-Major Henderson, and one or two gunners of the Royal Artillery were called to prove that the so-called tail-piece of the service skid was added only for convenience of fastening to the carriage, and, so far from having any utility in skidding, was an absolute detriment.

A great mass of evidence was produced on both sides, no less than 110 affidavits having been filed, and more than twenty witnesses were cross-examined in court.

The Vice-Chancellor could not but regret that so expensive a litigation had been carried on in this case, because it was clear that the improvement introduced by Mr. Poupard was one of great public utility, and had been acquiesced in by the public for a period of ten years before the bill was filed, while it appeared that the success of this suit could only have the effect of saving the defendant £2 or £3 a year till the expiration of the patent in January 1873. Upon a careful examination of the evidence, he came to the conclusion that there had been no prior user, as alleged, and that the defence set up on that ground was of a most frivolous and vexatious character. As to the point of law raised with regard to the specification, no doubt an inventor, in consideration of the monopoly given to him for fourteen years, was bound to make a full and fair disclosure to the public of what his invention consisted, but Lord Eldon's view that the specification must be so precise as to enable a person to make the article without the drawings was no longer the law, for a specification might now consist of a figure only. Mr. Poupard's specification, with the drawings accompanying it, explained his invention with sufficient clearness to prevent the public from being misled. The words "but I do not limit myself to so shaping it," would have been better omitted, but upon none of the authorities cited and upon no principle of justice could he come to the conclusion that the introduction of them vitiated the patent. The plaintiff was entitled to the perpetual injunction for which he asked, to the delivery up by the defendant of all patented skids in his possession, to an account and to an inquiry as to damages, and the defendant must pay all the costs of the suits.

TEASING COTTON.—TATHAM *v.* DANIA.—Court of Common Pleas; before Lord Chief Justice Bovill, and Justices Willes and Keating. November 16, 1869. Mr. Holker, Q.C., and Mr. Aston, appeared for the plaintiff; and Mr. Manisty, Q.C., and Mr. Edwards for the defendant.

This was an action to recover damages for the alleged infringement of a patent for tearing up cotton waste, so that it could be spun and woven over again. At the trial at Manchester the verdict was for the plaintiff, but the question now was whether a rule should be made absolute to enter a verdict for the defendant.

The Lord Chief Justice in delivering judgment said the specification was too wide. It sought to claim both what was new and what was old, and what it claimed as new, even if the subject of a patent, was not distinguished from the claim from that part of the patent which was admitted to be old. The only novelty consisted in running a pair of rollers formerly in use at a greater velocity than certain other rollers. It appeared to him that it was very doubtful whether this as claimed was the subject of a patent, as it was a process perfectly well known, and in use in many kinds of machines. Mr. Justice Willes and Mr. Justice Keating concurred, and judgment was given for the defendant.

## REVIEWS OF NEW BOOKS.

*The School Arithmetic* &c. By J. Cornwell, Ph.D., and J. G. Fitch, M.A. 10th edit.; small 8vo. Simpkin & Marshall. 1869.

THIS is a very small book to be the joint production of a philosophical doctor and a master of arts; but we rather like smallness—in elementary educational books. Of this, though said here to have reached its 10th edition, we cannot say that it is much better nor worse than the mass of such-like British school-books. It is

clear enough everywhere—a great merit—but it seems to want completeness, and also excision. We have, in fact, no definitions. Fractions and decimals are both treated of, but we are nowhere told what a fraction is; probably this is better than the old definition of Gough and Cocker's days, which still survives in many places, namely, "a fraction is a *broken* number;" more etymologically true, if true at all, than clear to child or man. So, too, we should have thrown out the tables of obsolete (so headed) weights and measures, and given at least the metric equivalents of our British standards.

Above all, the useful and rapid German "chain rule" for working sums in compound proportion, which can thus be done almost by the eye, and in a moment or two for cases of six or more proportions combined, should no longer be ignored in our educational books on arithmetic.

## FOREIGN LITERATURE.

*Leitfaden zur Bergbaukunde etc.*, von Bergrath Heinrich Lottner, bearbt. und herausg. von A. Serlo, Berghauptmann. 2 vols. 8vo. Berlin, 1869.

Heinrich Lottner has long been well known throughout all German lands as an able mining engineer, and even in Great Britain and elsewhere by his fine maps and sections of the great Westphalian coal formations—in which region a good deal of his earlier practice lay.

His work on practical mining, now edited by A. Serlo, another competent miner, though having the title of mining for all useful minerals is, in fact, mainly directed to coal-workings, though, no doubt, the methods thus applied are far more widely applicable in most of their details. It is with regret that we see the work commenced by a necrologic notice of the labours of its original author.

As a systematic treatise upon coal-mining, embracing in its nine great sections the entire range of operations—from the boring in search of coal to the means for keeping dry and well-ventilated, the shafts and galleries &c., and for the output of the coal, together with the entire economy, internal polity, and good-working of the pit—this work is the very best with which we are acquainted; and in these days of much talk at least, as to technical education, we might fitly suggest its translation into English, in which form no better manual could be given to the student coal-viewer, nor any more convenient remembrancer and suggester to the experienced colliery manager. The work is printed in Roman characters, and therefore can be read without eye-strain by those familiar with German. It is full of excellent woodcut illustrations—no less than 358 in the two volumes, with a few lithographs—has copious references in foot-notes to original authorities, and, as is now usual in German works of pure or applied science, a good bibliography of its subjects at the end. We shall not attempt extracts; we may notice, however, the very complete way in which the important subject of ventilation is handled, and the very clear comparison (with formulæ for each machine) in which the several ventilating machines, rotatory or other, which have been proposed, are discussed.

*Industries anciennes et modernes de l'Empire chinois.* Par Stan. Julien et P. Champion. Lacroix, Paris, 1869. 1 vol. 8vo. Plates.

This is a very interesting volume upon the arts, manufactures, and industries of China, and by no means devoid of significance for those in the western world of Europe and of America engaged in like or corresponding avocations; while, to the archæologist and ethnologist, it is full of curious matter.

The documents from which the work has been composed are Chinese, and have been translated by M. Julien, a member of the Institut, while original technological and scientific notes and additions have been supplied by M. Champion, Assistant-Professor of Chemistry at the *École centrale des Arts et Métiers*, at Paris.

All the great Chinese industries which correspond to ours—coal-mining, salt manufacture, lime-burning, preparing sulphur, alkalics, gun-powder, glass-making—are described; after which a multitude of special arts follow, several of which are peculiar, more or less, still to China. Then we have dyeing and colouring, glues, varnishes, oils, candle-making, inks—including the well-known india-ink, the nature of which is even yet not fully known—and paper-making, which occupies a space large in proportion to the importance of that product in China and Japan. Agriculture and manures, tea-growing, sugar-making, and distilling of alcohols, and silk-culture—all are treated of.

Besides all these there is quite a crop of highly curious information as to ingenious methods—"dodges," in our vulgar slang—for doing a large number of things, as to which we "barbarians" knew little or nothing before; amongst which are some of the conjuring tricks which have made latterly Chinese and Japanese jugglers inimitable and famous all over the world.

The publisher has done his work in his usual style, and we need say no more as to any work brought forth by Lacroix.

*Grundriss der Thermochemie; oder die Lehre von den Beziehungen zwischen Wärme und chemischen Erscheinungen.* Von Dr. Alex. Naumann. Pamphlet, 8vo. 1869.

This is a new and important addition to the ever-extending applications of that fertile philosophy—the relations between heat and work—which has sprung into existence, as it were, but yesterday.

In this brief and able memoir Dr. Naumann, Professor of Chemistry at the University of Giessen, extends his own and the scattered researches and papers of other philosophers into a pretty complete system of doctrine of the relations between *heat and chemical action*, viewed from the heat and work stand-point.

The work is too abstruse and too consecutively connected, for us to give any idea of its contents by extracts. While it will have its highest recognition amongst men of pure scientific research, we may direct to it the attention of every engineer and mechanician engaged with chemical or metallurgic manufactures, or with furnaces, as forming part of the philosophy which such men, in the next generation, at least, will have to apply.

## CORRESPONDENCE.

☞ We do not hold ourselves responsible for the views or statements of Correspondents.

### A PROBLEM.

TO THE EDITOR OF THE PRACTICAL MECHANIC'S JOURNAL.

Sir,—Will some of your scientific readers solve the following problem?—Take a globe or circular body of any size that can be constructed. There will be only one spot (the apex) where a theodolite would find a level, and this only in the absence of any rotatory motion. How is it that on this earth, which *is called* a sphere, and constantly rotatory, will give a level on every portion of its surface, north, south, east, and west, and that, too, during a rapid motion of 1,000 miles per hour? I am sorely puzzled. Will any one, who can, enlighten me?

Swindon, Wilts. John Hampden, Engineer.

Veritably John Hampden, Engineer, is a simpleton—or is joking with us.

Does he not see any difference between a sphere, however big or little, *upon* this earth of ours, of which his sphere is then only one portion of our earth's surface—and the entire spheroid which constitutes our planet? His sphere standing on our earth can have only one point on its surface whereon "a Dumpy" will stand and show level, because that is the only point at which the centre of the spirit level "bubble" shall be in a radius of our planet drawn through the centre of his sphere; and if he knocked away his sphere, and put the Dumpy level down on the earth's surface, exactly on the spot where his sphere and the earth's surface (assumed there level, like the sea) had been in contact, the bubble would still stand level. His sphere has no attraction in presence of the enormous attraction of our planet; and as this may be supposed all acting at the centre of its figure (or earth's centre), so the same phenomena follow wherever on its surface we place the Dumpy.

If Mr. Hampden's sphere had sensible attraction *of its own*—let us say, was another planet as big and with the same mean density as our earth, and that the two spheroids touched each other—then there would be but one spot on either at which the Dumpy could show a level line, viz. at the most distant extremities of a line passing through the centre of both. Has Mr. Hampden ever realised to himself what "a level line" means, at all?

As regards the motion of the earth affecting the level: if our correspondent be serious, it ought to be enough to ask him, does he find any difficulty in sitting upright or lying flat in a railway-carriage, after that has got into uniform motion, though whirling along with it at the rate of fifty miles an hour? Ed.

# PROCEEDINGS OF SCIENTIFIC SOCIETIES.

## THE MEETING OF THE BRITISH ASSOCIATION AT EXETER.

### SECTION G.—MECHANICAL SCIENCE.

The President, Mr. G. W. Siemens, delivered the opening address. After some general observations in support of the patent laws, the president went on to say that in his opinion the greatest illustration of the beneficial working of the patent laws was supplied by James Watt when, just about a hundred years ago, he patented his invention of a hot working cylinder and separate steam-engine condenser. After years of contest against those adverse circumstances that beset every important innovation, James Watt, with failing health and scanty means, was only upheld in his struggle hy tbe deep conviction of the ultimate triumph of his cause. This conviction gave him confidence to enlist the co-operation of a second capitalist after the first had failed him, and for asking for an extension of his declining patent. Without this opportune help Watt could not have succeeded to mature bis invention. He would, in all probability, have relapsed into the mere instrument-maker, with broken health and broken heart; and the invention of the steam-engine would not only have been retarded for a generation or two, hut its final progress would have been based probably upon the coarser conceptions of Papin, Savory, and Newcomen.

It can easily be shown that the perfect conception of the physical nature of steam, which dwelt like a heaven-born inspiration in Watt's mind, was neither understood by his contemporaries, nor by his followers, np to very recent times, nor can it be gathered from Watt's imperfect specification. James Watt was not satisfied to exclude the condensing water from his working cylinder and to surround the samo by non-conducting substnnces, but he placed between the cylinder and the non-conducting envelope a source of heat in the form of a steam-jacket filled with steam, at a pressure somewbat superior to that of the working steam. His successors have not only discarded the steam-jacket, and even condemned it on the superficial plea that the jacket presented a larger and hotter surface for loss by radiation than the cylinder, but expansive working was actually rejected by some of them on the ground that no practical advantage could be obtained by it. The modern engine had, in fact, degenerated in many instances into a virtual steam meter, constructed apparently with a view of emptying tlie boiler in the shortest possible space of time. It was only duriog the last twenty years that the subtle action of saturated steam (in condensing upon the sides of the cylinder when under pressure, and of re-evaporating when the pressure is relieved toward the end of each stroke,) has been again recognised and insisted upon by Lechatelier and others who have shown the necessity of a slightly superheated cylinder in order to realise the expansive force of steam. The result has been a reduction in the consnmption of fuel in our best marine engines from 6lh. or 8lb. to helow 3lb. per gross indicated horse-power.

In viewing the latest achievements of engineering science two works strike the imagination chiefly hy their exceeding magnitude, and by the influence they are likely to exercise upon the traffic of the world. The first of these is the great Pacific Railway, which, in passing through vast regions hitherto inaccessible to civilised man, and over formidable mountain chains, joins California with the Atlantic states of the grent American republic. The second is the Suez shipping canal, which, notwithstnnding adverse prognostications and serious difficulties, will be opened very shortly to the commerce of the world. These works must greatly extend the range of commercial enterprise in the North Pacific and the Indian Seas. The new waterway to India will, owing to the difficult navigation of the Red Sea, be in effect only available for ships propelled hy steam, and will give a stimulus to that branch of engineering. Telegraph communication with America has been rendered more secure against interruption by the successful submersion of the French Transatlantic cable. On the other hand, telegraphic communication with India still remains in n very unsatisfactory condition, owing to imperfect lines and divided administration. To supply a remedy for this public evil the Indo-European Telegraph Company will shortly open its special lines for Indian correspondence. In northern Russia the construction of a land line is far advanced to connect St. Petersburg with the mouth of the Amoor River, on completion of which only n submarine link between the Amoor nnd San Francisco will be wanting to complete the telegraphic girdle round the earth. With tbese great highways of speech once established, a network of submarine and aerial wires will soon follow to bind all inhabited portions of our globe together into a closer community of interests, which, if followed up by steam communication hy land and by sea, will open out a great and meritorious field for the activity of the civil nnd mechanical engineer. But while great works have to be carried out in distant parts, still more remains to he accomplished nearer home. The railway of to-day has not only taken the place of high roads and canals for the transmission of goods nnd passengers between our great centres of industry and population, but is already superseding bye-roads leading to places of inferior importance ; it competes with the mule in carrying minerals over mountain passes, and with the omnibus in our great cities. If a river cannot he spanned hy a bridge without hindering navigation a tunnel is forthwith in contemplation, or, if that should not be practicahle, the transit of trains is yet accomplished by the establishment of a large steam ferry. It is one of the questions of the day to decide by which plan the British Channel should be crossed, to relieve the unfortnnate trnveller to the continent of the exceeding discomfort nnd delay inseparable from the existing most imperfect arrangements. Considering that tbis question has now been taken up by some of our leading engineers, and is also entertained by the two interested Governments, we may look forward to its speedy and satisfactory solution. So long as the attention of railway engineers was confined to the construction of main lines it was necessary for them to provide for a henvy traffic and high speeds, and these desiderata are best met by a level permanent wny, by easy curves and heavy rails of the strongest possible materials, namely, cast-steel; hut, in extending the system to the corners of the earth, cheapness of construction and maintenance, for a moderate speed and a moderate amount of traffic, become a matter of necessity. Instead of plunging through hill and mountain, and of crossing and recrossing rivers by a series of monumental works, the modern railway passes in zigzag up the steep incline, and conforms to the windings of tbe narrow gorge; it can only be worked hy light rolling stock of flexible construction, furnished with increased power of adhesion and great hrake power. Yet by the aid of the electric telegraph, in regulating the progress of each train, the number of trains may be so increased as to produce, nevertheless, a large aggregate of traffic; and it is held by some that our trunk lines even would he worked more advantageously by light rolling stock. The hrake power on several of the French and Spanish railways has been greatly increased by an ingenious arrangement conceived by M. Lechatelier, of applying what has been termed "contre vapour" to the engine, converting it for the time being into a pump, forcing steam and water into the boiler. While the extension of communication occupies the attention of, perhaps, the greater number of our engineers, others are engaged upon weapons of offensive and defensive warfare. We have scarcely recovered our wonder at the terrific destruction dealt by the Armstrong gun, the Whitworth bolt, or the steel barrel consolidated under Krupp's gigantic steam-hammer, when we hear of a shield of such solidity and toughness as to bid defiance to them all. A larger gun or a hard bolt by Palliser or Grüsen is the successful answer to this challenge; when again defensive plating, of greater tenacity to absorb the power residing in the shot, or of such imposing weigbt and hardness combined as to resist the projectile absolutely (causing it to be broken np hy tbe force residing within itself) is brought forward. The ram of war, with heavy iron sides, which a few years since was thought the most formidable, as it certainly was tbe most costly, weapon ever devised, is already being superseded hy vessels of the *Captain* type, as designed by Captain Coles, and ably carried out by Laird Brothers, with turrets (armed with guns of gigantic power) that resist the heaviest firing, hoth on account of their extraordinary thickness and of the angular direction in which the shot is likely to strike. By an ingenious device Capt. Moncrieff lowers his gun upon its rocking carriage after firing, and therehy does away with embrasures (the weak places in protecting works), while at the same time he gains the advantage of reloading his gun in comparative safety. It is presumed that in thus raising formidable engines of offensive and defensive warfare the civilised nations of the earth will pause before putting them into earnest operation, but if they should do so it is consolatory to think that they could not work them for long without effecting the total exhaustion of their treasuries, already drained to the utmost in their construction. While science and mechanical skill combine to produce these wondrous results tbe germs of further and still greater achievements are matured in our mechanical workshops, in our forges, and in our metallurgical smelting works; it is there that the materials of construction are prepared, refined, and put into such forms as to render greater and still greater ends attainable. Here a great revolution of our constructive art has been prepared by the productiou, in large quantities and at moderate cost, of a material of more than twice the strength of iron, which instead of being fibrous has its full strength in every direction, and which can he modulated to every degree of ductility, approaching the hnrdness of the diamond on the one hand and the proverbial toughness of leather on the other. To call this material cast-steel seems to attribute to it hrittleness and uncertainty of temper whicb, however, are by no means its necessary characteristics. This new material, as prepared for constructive purposes, may indeed he both hard and tough, as is illustrated by the hard steel rope that has so materially contrihuted to the practical success of steam-ploughing. Machinery steel has gradually come into use since about 1850, when Krupp, of Essen, commenced to supply large ingots that were shaped into railway tyres, axles, cannon &c., hy melting steel in halls containing hundreds of melting crucibles. The Bessemer process, in dispensing with the process of puddling, and in utilising the carbon contained in the pig-iron to effect the fusion of the final metal, has given a vast extension to the application of cast-steel for railway hars, tyres, boiler-plates &c. This process, however, is limited in its application to superior brands of pig-iron, containing much carbon and no sulphur or phosphorus, which latter impurities are so destructive to the quality of steel. The puddling process has still, unless the process of decarburisation of Mr. Heaton takes its place, to be resorted to, to purify these inferior pig-irons, which constitute the hulk of our productions; and the puddled iron cannot be brought to the condition of cast-steel except through the process of fusion. This is accomplished successfully in masses of from three to five tons on the open bed of a regenerative furnace at the Landore Siemens Steel Works, and at otber places. At the same works cast-steel is also prodnced, to a limited extent as yet, from iron ore, which, being operated upon in large masses, is redneed to the metallic state and liquefied hy the aid of a certain proportion of pig metal. The regenerative gas furnace—the application of which to glass-houses, to forges &c., has made considerahle progress—is unquestionahly well suited for this operation, because it combines an intensity of heat, limited only hy the point of fusion by the most refractory material, with extreme mildness of draught and chemical neutrality of flame. These and other processes of recent origin tend townrd the production, at a comparatively cheap rate, of a very high class material that must shortly supersede iron for almost all structural purposes. As yet engineers hesitnte, and very properly so, to construct their bridges, their vessels, and their rolling stock of the material produced by these processes, because no exhaustive experiments have been puhlished as yet fixing the limit to which they may safely be loaded in extension, in compression, and in torsion, and because as yet no sufficient information has been obtained regarding the tests by which their quality can best he nscertained. This great want is in a fair way of being supplied by the experimental researcbes that have been carried on for some time at her Majesty's dockyards at Woolwich under a committee appointed for that purpose by the Institution of Civil Engineers. The president had also the pleasure to announce an elaborate report by Mr. Wm. Fairbairn on this subject. In the meantime excellent service has been rendered hy Mr. Kirkaldy in giving us, in a perfectly reliable manner, the resisting power and ductility of any sample of material which we wish to submit to his tests. The results of Mr. Whitworth's experiments tending to render the hammer and the rolls obsolete by forcing cast-steel, while in a semi-fluid state, into strong iron moulds by hydraulic pressure, are looked upon with

great interest. But, assuming that the new building material has been reduced to the utmost degree of uniformity and cheapness, and that its limits of strength are fully ascertained, there remains still the task for the civil and mechanical engineer to prepare designs suitable for the development of its peculiar qualities. If in constructing a girder, for example, a design were to be adopted that had been worked out for iron, and if all the scantlings were simply reduced in the inverse proportion of the absolute and relative strength of the new material, as compared with iron, such a girder would assuredly collapse when the test weight was applied, for the simple reason that the reduced sectional area of each part, in proportion to its length, would be insufficient to give stiffness. You might as well almost take a design for a wooden structure, and carry it out in iron by simply reducing the section of each part. The advantages of using the stronger material become most apparent if applied, for instance, to large bridges, where the principal strain upon each part is produced by the weight of the structure itself, for, supposing that the new material can be safely weighted to double the bearing strain of iron, and that the weight of the structure were reduced by one-half accordingly, there would still remain a large excess of available strength in consequence of the reduced total weight, and this would justify a further reduction of the amount of the material employed. In constructing works in foreign parts the reduced cost of carriage furnishes also a powerful argument in favour of the stronger material, although its first cost per ton might largely exceed that of iron.

The inquiries of the Royal Coal Commission into the extent and management of the coalfields appear to be reassuring as regards the danger of their becoming soon exhausted; nevertheless, the importance of economising these precious deposits in the production of steam-power, in metallurgical operations, and in domestic use, can hardly be over-estimated. The calorific power resulting in a pound of coal of a given analysis can now be accurately expressed in units of heat, which again are represented by equivalent units of force or of chemical action; therefore, if we ascertain the consumption of coal of a steam-engine, or of a furnace employed in metallurgical operations, we are able to tell by the light of physical science what proportion of the heat of combustion is utilised and what proportion is lost. Having arrived at this point we can also trace the channels through which loss takes place, and in diminishing these by judicious improvement we shall more and more approach those standards of ultimate perfection which we can never reach, but which we should, nevertheless, keep steadfastly before our eyes. Thus, a pound of ordinary coal is capable of producing 12,000 Fahrenheit units of heat, which equal 2,240,000 foot-pounds, or units of force; whereas the very best performances of our pumping-engines do not exceed the limit of 1,000,000 foot-pounds of force per pound of coal consumed. In like manner, 1lb. of coal should be capable of heating 33lb. of iron to the welding point of (say) 3,000 deg. Fah., whereas, in an ordinary furnace, not 2lb. of iron are so heated with 1lb. of coal. These figures serve to show the great field for further improvement that lies yet before us. Although heat may be said to be the moving principle by which all things in nature are accomplished, an excess of it is not only hurtful to some of our processes, such as brewing, and destructive to our nutriments, but to those living in hot climates or sitting in crowded rooms an excess of temperature is fully as great a source of discomfort as excessive cold can be. Why, then, he asked, should we not resort to refrigeration in summer as well as to calorification in winter, if it can be shown that the one can be done at nearly the same cost as the other?

August 20.—"Interim Report of the Committee on Agricultural Machinery," by Professor Rankine.

"Interim Report of the Committee on the Laws governing the Flow and Action of Water containing Solid Matter in Suspension," by Professor Rankine.

"On the Laws determining the Fracture of Materials when sudden Changes of Thickness take place," by Mr. F. J. Bramwell.

Mr. J. F. Bateman then described a scheme, devised by himself and Mr. J. J. Revy, member of the Institute of Civil Engineers of Vienna, for a "Channel Railway."

"On a Navigable Floating-Dock," by Admiral Sir E. Belcher.

August 22.—Mr. L. E. Fletcher read the "Report of the Committee on Coroners' Inquests in Connection with Steam-boiler Explosions."—The conclusions at which the Committee arrived were—First, that a lamentable loss of life is annually caused by steam-boiler explosions, which urgently calls for public attention. Secondly, that these explosions, as a rule, are not "accidental," but may be prevented by the exercise of "common knowledge and common care." Thirdly, that the present investigations conducted by coroners with regard to steam-boiler explosions are eminently unsatisfactory, and call for immediate improvement. Fourthly, that coroners should, when conducting enquiries on boiler explosions, be empowered to avail themselves of competent engineering advice, so that the cause of every boiler explosion may be fully investigated, while the information thus acquired should be widely circulated. Fifthly, the Committee entertain a sanguine hope that this course alone would do much towards the prevention of the present recurrence of steam-boiler explosions, without any further Governmental action. Parties using steam-boilers would thus become responsible in damages for any loss of life or injury arising from their negligence.

Mr. C. W. Merrifield read the "Report of the Committee on the State of existing Knowledge on the Stability, Propulsion, and Sea-going qualities of Ships."

Professor W. J. M. Rankine read the "Report of the Committee for the Analysis and Reduction of the Observations and Facts collected by the Steamship Performance Committee."

Mr. R. B. Grantham read the "Report of the Committee on the Treatment and Utilisation of Sewage," appointed at Norwich last year, jointly with Sections C. and F.

"On Roads and Railways in Northern India as affected by the Abrading and Transporting Power of Water," by Mr. T. Login.

"On the Penetration of Armour-Plates with Long Shells containing Large Bursting-Charges fired obliquely," by Dr. J. Whitworth.

"On Government Action with regard to Steam-Boiler Explosions," by Mr. L. E. Fletcher. The author deprecated Government inspection, and advocated the suggestions of the Committee.

August 23.—"Report of the Tidal Committee," by Professor Rankine.

Adjourned Discussion on Mr. L. E. Fletcher's paper "On Boiler Explosions."

"On the Utilisation of Town Sewage," by Mr. T. D. Barry.

"On the Birmingham Wire Guage," by Mr. L. Clark.

"On a New System of Communication between Guards and Passengers on Railways," by Mr. S. A. Varley.

"On the Method of determining the True Amount of Evaporation from a Water Surface," by Mr. G. J. Symons and Mr. R. Field.

"On the Hydraulic Internal Scraping of the Torquay Water Main," by Mr. R. E. Froude.

"On some Difficulties in the Received Views of Fluid Friction," by Mr. W. Froude.

"Description of a New System of House Ventilation, by J. D. Morrison, of Edinburgh," by Professor T. C. Archer.

"On the Working of Thomson's Road Steamer during the past year," by Professor T. C. Archer.

"On an Improved Vertical Annular High-Pressure Steam-Boiler," by Mr. W. Smith.

## THE INSTITUTION OF CIVIL ENGINEERS.

### Premiums, Session 1868-69.

The Council of the Institution of Civil Engineers have awarded the following premiums:—

1. A Telford medal, and a Telford premium, in books, (to consist of a complete set of the publications of the Institution), to M. Jules Gaudard, C.E., Lausanne, for his paper "On the Present State of Knowledge as to the Strength and Resistance of Materials."

2. A Telford medal, and a Telford premium, in books, to William Shelford, M. Inst. C.E., for his paper, "On the Outfall of the River Humber."

*3. A Watt medal, and a Telford premium, in books, to Zerah Colburn, M. Inst. C.E., for his paper, "On American Locomotives and Rolling Stock."

4. A Telford medal, and a Telford premium, in books, to Thomas Nesham Kirkham, M. Inst. C.E., for his paper "Experiments on the Standards of Comparison employed for Testing the Illuminating Power of Coal Gas."

5. A Telford medal, and a Telford Premium, in books, to John Ellacott, M. Inst. C.E., for his "Description of the Low Water Basin at Birkenhead."

6. A Telford medal, and a Telford premium, in books, to Professor David Thomas Ansted, F.R.S., for his paper "On the Lagoons and Marshes of certain parts of the Shores of the Mediterranean."

7. A Telford premium, in books, to William Henry Wheeler, M. Inst. C.E., for his "Description of the River Witham and its Estuary, and of the various Works carried out in connection therewith, for the Drainage of the Fens, and the Improvement of the Navigation."

8. A Telford premium, in books, to James Robert Mosse, M. Inst. C.E. for his paper on "the Mauritius Railways—Midland line."

9. A Telford premium, in books, to Imrie Bell, M. Inst. C.E., for his paper "On Sinking Wells for the Foundations of the Piers of the Bridge over the River Jumna, Delhi Railway."

10. A Telford premium, in books, to John Milroy, Assoc. Inst. C.E., for his "Description of Apparatus for Excavating under Water, and for Sinking Cylinders."

11. A Telford premium, in books, to Samuel Parker Bidder, jun., Assoc. Inst. C.E., for his paper "On Machines employed in Working and Breaking-down Coal, so as to avoid the use of Gunpowder."

12. A Telford premium, in books, to Charles John Chubb, for his paper "On Coal-getting Machinery as a substitute for the use of Gunpowder."

13. The Manby premium, in books, to David Marr Henderson, Assoc. Inst. C.E. for his paper "On Lighthouse Apparatus and Lanterns."

The Council have likewise awarded the following prizes to students of the Institution:—

1. A Miller prize to Edward Bazalgette, Stud. Inst. C.E., for his paper "On the Use of Concrete in Building Operations."

2. A Miller prize to Frederick Harry Mort, Stud. Inst. C.E., for his paper "An Inquiry into the Nature and Causes of some discrepancies between Theory and Practice."

3. A Miller prize to Tristie James Ellis, Stud. Inst. C.E., for his paper "On the Artistic Design of Bridges."

4. A Miller prize to Thomas Robert Gainsford, Stud. Inst. C.E., for his paper "On the Construction of a Railway Tunnel, or Covered Way, at Bradford, Yorkshire, among abandoned Coal and Ironstone Workings."

5. A Miller prize to Charles Henry Grey Jenkinson, Stud. Inst. C.E., for his paper "On Wrought Iron Girder Bridges."

6. A Miller prize to George Henry Roberts, Stud. Inst. C.E., for his paper "On Reservoir Embankments."

### Subjects for Premiums, Session 1869-70.

The Council of the Institution of Civil Engineers invite communications on the subjects comprised in the following list, as well as upon others; such as (1) authentic details of the progress of any work in civil engineering, as far as absolutely executed (Smeaton's Account of the Eddystone Lighthouse may be taken as an example); (2) descriptions of engines and machines of various kinds, or (3) practical essays on subjects connected with engineering, as, for instance, metallurgy. For approved original communications, the Council will be prepared to award the premiums arising out of special funds devoted for the purpose.

1. On steam and hydraulic cranes, and on the application of steam power in the execution of public works.

2. On the different systems and the results of the use of road traction engines.

3. On the theory and details of construction of metal and timber arches.

4. On land-slips, with the best means of preventing, or arresting them, with examples.

5. On the principles to be observed in laying-out lines of railway through mountainous countries, with examples of their application in the Alps, the Pyrenees, the Indian Ghats, the Rocky Mountains of America, and similar cases.

6. On the working expenses of railways.

7. On railway ferries, or the transmission of railway trains entire across rivers estuaries, &c.

8. On the systems of fixed signals at present in use on railways.

9. Description of a modern locomotive engine, designed with a view to cheapness of construction, durability, and facility of repair.

10. On the cost of maintenance of railway locomotives.

11. Description of continuous brakes which have been extensively employed on railways, and the general results.

12. On the most suitable materials for, and the best mode of formation of, the surfaces of the streets of large towns.

13. On the construction of catch-water reservoirs in mountain districts, for the supply of towns for irrigation, or for manufacturing purposes.

14. Accounts of existing waterworks; including the sources of supply, a description of the different modes of collecting and filtering water, the distribution to the consumer, and the general practical results.

15. On pumping machinery for raising water, both for high and low lifts.

16. On the principles applicable to the drainage of towns, and the disposal of the sewage.

17. On the employment of steam power in agriculture.

18. On the ventilation and warming of public buildings.

19. On the design and construction of gasworks, with a view to the manufacture of gas of high illuminating power; and on the most economical system of distribution of gas, and the best modes of illumination in streets and buildings.

20. Description of successfully applied gas engines.

21. Critical observations on tides, and particularly as affecting coasts, estuaries, rivers, docks, and navigation.

22. On the maintenance, by sluicing. of the harbours on the coast of France, Belgium, and Holland.

23. Description of the sea works at the mouth of the river Maas, and the effects produced thereby.

24. On the construction of tidal or other dams in a constant or variable depth of water, and on the use of wrought iron in their construction.

25. On the arrangement and construction of floating landing-stages for passenger and other traffic, with existing examples.

26. On the different systems of swing, lifting, and other opening bridges, with existing examples.

27. On the measure of resistance to bodies passing through fluids at different velocities, and of fluids passing through pipes and in channels.

28. On the results of the best modern practice in ocean steam navigation, having regard particularly to economy of working expenses, by superheating, surface condensing, great expansion, high pressure, &c.: and on the "life" and cost of maintenance of merchant steamships.

29. On the practical employment of heated air as a motive power.

30. On ships of war, with regard to their armour, ordnance, mode of propulsion, and machinery.

31. On the measures to be adopted for protecting iron and iron ships from corrosion.

32. On coal mining in deep workings.

33. On colliery explosions, and on the influence of different modes of "getting" coal on the safety of mines.

34. On the present systems of smelting iron ores; of the conversion of cast iron into the malleable state and into steel, and of the manufacture of iron and steel generally comprising the distribution and arrangement of iron and steel works.

35. On machinery for rolling heavy rails, shafts, and bars of a large sectional area, and for forging heavy masses of metal.

36. On steel, and its present position as regards production and application.

37. On the safe working strength of cast and malleable iron and steel, including the results of experiments on the elastic limit of long bars of iron, and on the rate of decay by rusting, &c., and under sudden and prolonged strains.

38. On machinery for washing lead ores.

39. On the present state of submarine telegraphy, and on the transmission of electrical signals through submarine cables.

The Council will be glad to receive, for the purpose of forming an "appendix" to the minutes of proceedings, the details and results of any experiments or observations on subjects connected with engineering science or practice.

The Council will not consider themselves bound to award any premium should the communication not be of adequate merit, but they will award more than one premium should there be several communications on the same subject deserving this mark of distinction. It is to be understood that, in awarding the premiums, no distinction will be made, whether the communication has been received from a member or an associate of the Institution, or from any other person, whether a native or a foreigner.

The communications must be forwarded on or before the 1st of February, 1870, to the house of the Institution, No. 25, Great George-street, Westminister, S.W., where copies of this paper, and further information, may be obtained.

## LONDON ASSOCIATION OF FOREMEN ENGINEERS.

The ordinary monthly meeting of members was held at the City Terminus Hotel, on Saturday, the 6th ult. It was well attended, and the chair as usual was filled by the president of the Institution, Mr. Newton, of the Mint. After the transaction of the routine business of the evening, Mr. John Humes (of Messrs. Easton and Amos) proceeded to read a paper on the "Warsop Aero Steam Engine." This contrivance was described by Mr. Eaton at the recent meeting of the British Association. Mr. Humes, however, explained the latest phase of the invention, with the mode now adopted for passing heated air into the steam boiler of the engine, and ultimately into the cylinders. A discussion of a searching and practical nature followed the paper, and in this Messrs. Ives, Edmonds, Sisson, Eaton, Irvine, the chairman, and others joined. Mr. Humes replied in such a way as to dispel objections.

## THE SOCIETY OF ENGINEERS.

At the last ordinary meeting of the Society of Engineers, held on Monday, the 1st ult., in the Lower Hall, Exeter Hall, a discussion took place on a paper read by Mr. Perry F. Nursey, on the 18th of October, "On English and Continental Intercommunication." The following candidates for election were balloted for and duly elected, viz., as members, Messrs. John Eunson, jun., engineer to the Northampton Gas Company; Edward V. O. Haldane, late assistant engineer, Hyderabad, Deccan; John Green Hall, city surveyor, Canterbury; Mathew J. Jennings, C.E., Durham lodge, New Cross; William Roebuck, Ellington-street, Arundel-sqnare; Thomas Small, M.E., Gloucester; Robert P. Spice, consulting engineer, 21 Parliament-street; Thomas Warden, M.E., Birmingham; Thomas Welkins, M.E., Orchard Works, Ipswich. As a foreign member, Lieut. John Guerson, Bombay Staff Corps, later R.A. As an associate, Samuel Catlor, jun., Providence Iron-works, Millwall, Poplar.

## THE ROYAL SCOTTISH SOCIETY OF ARTS.

The committee appointed by the Royal Scottish Society of Arts to award prizes for communications read and exhibited during Session 1868-69, have awarded the following prizes:—

1. To E. E. Sang, Civil and Mechanical Engineer, Edinburgh,—for his "Description of an Improved Variation Instrument," the Society's silver medal and plate, value ten sovereigns. 2. To R. H. Bow, C.E., F.R.S.E,—for his Paper on Photometry, the Society's silver medal and plate, value five sovereigns. 3. To W. J. Cockburn Muir, C.E., London,—for his Paper on Light Railways, the Society's honorary silver medal. 4. To T. C. Fidler, C.E., London,—for his "Note on the Question of Ruling Gradients," the Society's honorary silver medal. The committee recommend that while thanks are justly due to all those gentlemen who have sent communications, the special thanks of the Society be given to the following gentlemen:—1. To F. Jenkin, F.R.SS.L. and E., Professor of Civil Engineering in the University of Edinburgh,—for his "Address on Technical Education." 2. To R. W. Thomson, C.E., F.R.S.E.,—for his "Description of Captain Moncrieff's Barbette System." 3. To T. S. Wright, M.D., M.R.C.P.E.,—for his "Description of the Chromoskiastereoscope, an instrument for the production of harmoniously coloured forms." 4. To Messrs. A. M. Peters, Plumber, G. H. Sleight, Engineer, G. Romanes, C.E., and E. Sang, C.E.,—for their respective communications on the Regulation of Water Supply.

# MONTHLY NOTES.

Iron Fences, and Latches for the Gates thereof.—The accompanying engravings represent some ingenious arrangements (the invention of Mr. Charles Kennan, of Dublin, for securing or fixing the wires or wire ropes of strained wire fences in the upright standards or supports, and for securing or fixing the horizontal bars of continuous iron bar fences in their upright standards or supports; also an improved construction of latch or fastening for gates to be used in iron or other fences, or for other similar purposes.

In fig. 1 a staple cap A is fitted on the top of the standard B, and a hole is made through both A and B for the wire C to pass through freely; another hole is made in the standard B close to the bottom of the cap A, so that when the wedge D is driven therein, it forces the cap A upwards, and thereby causes the wire C to be firmly gripped by the opposite edges or inner surfaces of the holes in the cap A and

Fig. 1.

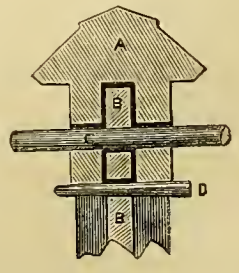
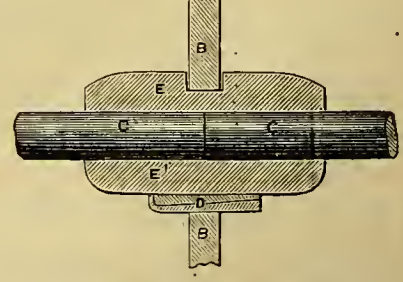



Fig. 2.




standard B through which it has been passed. Fig. 2 shows a mode of securing round bars of continuous iron fences to their standards. The horizontal bars C C (whether round or square) meet at the standard B, between two metal pieces E and E', which together with the bars C C fit into a hole made in the standard B. The proximate faces of E and E' are shaped so as to fit the bars C C, and a notch is formed on the piece E', which fits against the one end of the hole in the standard B, so that when the wedge D is driven between E' and the opposite end of the hole in

the standard B, the pieces E and E¹ are tightened on the bars C C, and all are secnred to the standard B. Figs 3 and 4 show Mr. Kennan's arrangement of latch or fastening. A is the case or frame of the latch, which may be of any convenient form, provided that the requisite bearings are preserved for the parts B and C; or those parts may be attached to the frame of a gate or door without a special casing. In fig. 3, the case A is shown bolted to the front bar E of an iron

Fig. 3.

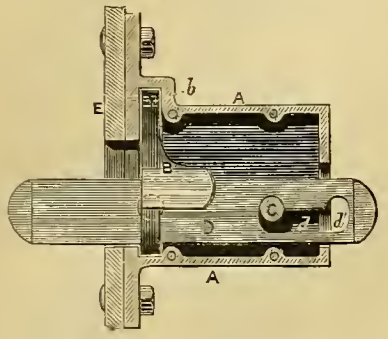
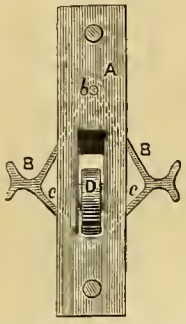



Fig. 4.




gate. The bolt D has a slotted hole *d* made therein at or near one end, which works on the stud or pin C, so that it can be moved backwards or forwards or npwards whilst still playing thereon. The piece B is hung on the pin or bolt *b*, and by moving it either backwards or forwards the inclined surfaces *c c* will raise the outer end of the bolt D. When the raising piece B is moved either backwards or forwards the bolt D will be lifted, whether the fulcrum *c* he at one end or the other of the slot *d*. Figure 3 shows the bolt drawn back so that a padlock may be hnng in the protrnding end *d*¹ of the slot *d*, and it is then used only as a latch.

Apparatus for Burling and Shearing Textile Fabrics.—The improvements represented in the annexed engravings were patented a short time since by Messrs. Schneider, Legrand, Martinot, & Co. of Paris, and relate to some of the details as well as to the general arrangement and combination of the various parts of that class of machinery for burling and shearing textile fabrics wherein reciprocating blades having channelled and serrated cutting edges are employed for burling and shearing the fabric, which is held in a distended state in contact with such blades.* The chief objects in view are the affording facility for accurately adjusting the distance between the contiguous cutting edges of the blades, and ensnring their perfect parallelism ; also the enabling both sides or surfaces of the piece of goods to be operated upon simultaneously in the same machine. Fig. 1 of the engravings is a horizontal section of one end of a pair of adjustahle burling-blades constructed according to these improvements ; and fig. 2 is a side elevation of the top part of the machine, adapted for burling or shearing both sides of the goods simultaneously, and to which is applicable the system of adjustable blades. At each extremity of the blades, that is to say, between the two wooden bars to which such blades are fixed, there is disposed a wedge of bronze or hard brass A (fig. 1) which may be moved backwards or forwards by means of the screw B, in order to adjnst or vary the distance between the two bars. This screw is secnred in the cast-iron frame or cap C, which latter is maintained in position hy the screw pins E. These pins are fixed in the wooden bars and slide freely in the direction of their longitndinal centre lines in the cast-iron frame or cap C, when the wooden bars are moved towards or from each other for the pnrpose of adjustment. The cloth or

Fig. 1.

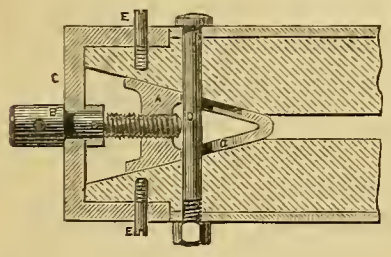
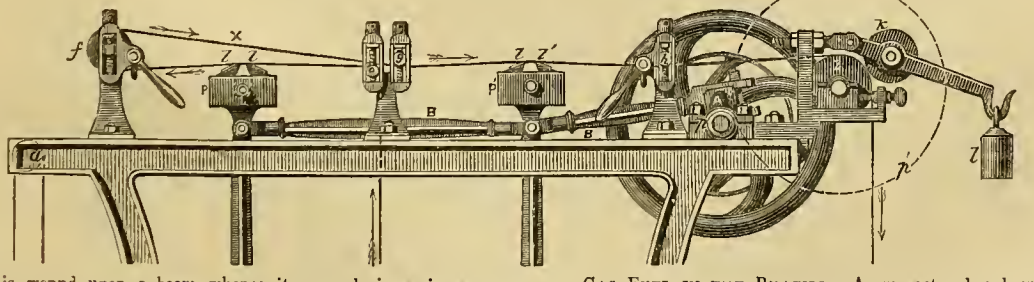
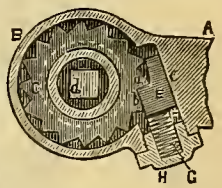



Fig. 2.




fabric X (fig. 2) is wonnd upon a beam, whence it proceeds in a zig-zag course between the steps or rounds of a ladder suspended below the bar or breast beam *a* ; it then passes on, to and over this bar or breast beam, and next to the steps or ronnds of a second ladder, whence it passes under one roller and over another, not shown in the engravings, below the bar or breast beam *a* and between two vertically adjustable rods which are adjusted by a ratchet arrangement (not shown in the engravings), in order to obtain the requisite tension, according to the resistance occasioned by the working of the blades ; the cloth then passes zig-zag fashion, as before, over the steps of a third ladder, and thence over the rods and movable rollers *e*, *f*, *g*, *h*, which serve to press the cloth or fabric on to the combs P and P'. The ladders are used in order to prevent the edges or selvages of the fabric from being curled up whilst proceeding to the first comb P. The rollers *i* and *k* are covered with woollen velvet, and serve to feed along the fabric as fast as the operation of bnrling proceeds. The crank axle A imparts motion to the combs P and P' by the connecting rods B, and to the velvet-covered rollers by gearing *p p'*, the latter wheel *p'* being fixed on the spindle of the roller *i* ; the weight *l* produces the requisite pressnre on the rollers *i* and k.

Ratchet Braces.—The peculiar construction of ratchet brace shown in the annexed engraving has been patented by Mr. John Sincock, of Birmingham. The inventor claims for it increased strength, simplicity, power and durability. The novelty consists in the employment of a sliding pall, acted upon by a helical spring enclosed in a spring-hox, for actuating the ratchet wheel of a ratchet brace or lever. The sliding pall, spring, and spring-box (which latter may be provided with a screwed cap or cover for the facility of removing the pall and spring) are all contained in the head of the actuating lever of the brace; and access to the ratchet wheel can be obtained by removing the hoop or bush which serves to keep the ratchet wheel in its place. This hoop is held in its place by two or more screws, on removing which all the parts can be readily taken out. By this arrangement the pall remains constantly in contact with the ratchet wheel, and consequently all possibility of slip is prevented, and a dead pull, with an entire absence of back lash or looseness, is ensured. The working parts are moreover wholly enclosed, and being of wrought-iron their durability may be increased by case-hardening them. This arrangement is applicable to ordinary ratchet levers and other purposes where ratchet wheels are employed.




The engraving is a plan of the tool with the head of the lever in horizontal section, in order to show the spring-hox with the peculiar ratchet and sliding pall and spring mechanism. A is the lever, and B the hollow head enclosing the ratchet wheel C, in the boss of which is keyed the socket *d* for the reception of the drill; E is the sliding pall, which is contained within the spring-box F formed on the lever head, and is pushed inwards tangentially to the ratchet wheel hy a helical spring G, the pall and spring being maintained in their places by the screwed cap or cover H; the front end of the sliding pall bears against the front or vertical face *a* of the ratchet teeth, whilst one side of the said sliding pall, having a flat surface, bears against the inclined or outer surface *b* of the teeth, and has a bearing on its opposite side at *e* against the back of the chamber containing the pall. On moving the lever handle in an upward direction the ratchet wheel will bo carried round with it, as the pall will remain fixed between the outer or inclined surface *b* of the tooth and the back *e* of the chamber, and consequently will carry the ratchet wheel round along with it. Bnt on reversing the motion of the lever A for the back stroke, the front end of the pall will encounter the vertical face *a* of the tooth, and the resistance thus offered will cause the pall to slide back and compress the spring G until the end of the tooth has passed, when the spring will force the pall forward again into the next tooth; thus allowing the lever to move back without acting upon the ratchet wheel. The ratchet wheel is kept in its place in the lever head by a hoop or bush, which fits inside the hollow head, and is secured therein by two or more screws.

The Cambria Iron Works.—The largest ironworks in America are the Cambria Works, at Johnstown, Pennsylvania. They cover an area of about five acres, run night and day, and give employment to about 3,000 hands. They contain 42 double furnaces, over each of which is a steam-boiler connected with the engine. The engine is a vertical one of 350 horse-power; its fly wheel is 30½ ft. in diameter, and weighs 56 tons. The capacity of the works is 1,400 tons of railroad iron per week. Last year they turned out 76,000 tons, and this year expect to produce 82,000.

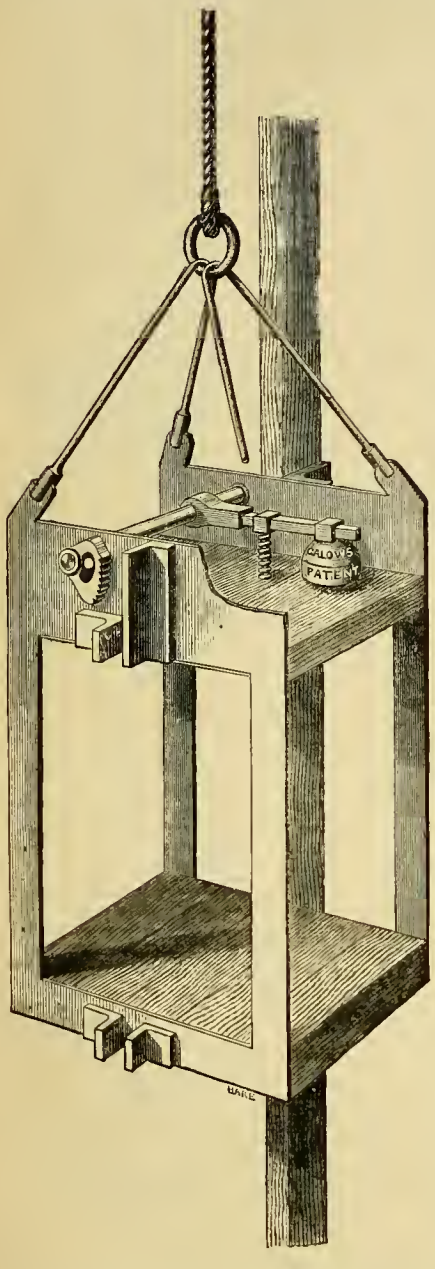
Annual International Exhibition of Art and Industry.—The permanent buildings for the first of the series in 1871, were commenced on the 15th instaut at South Kensington. Messrs. Lucas Brothers are the contractors.

Gas Fuel in the Brazils.—A prospectus has been issued of the Brazilian Gas Fuel Company (limited), with .a capital of £100,000, in shares of £10 (of which half is to be first subscribed), for working some extensive deposits of a combustible material called "turba," or "brown cannell," abont sixty miles from the city of Bahia, and which are believed to be almost inexhaustible. The gas-producing power of the "turba" is stated to be very great, while the cost of excavating and delivering it is small in comparison with that of coal. The concession obtained

* The machine to which these improvements apply has been already noticed in our pages. (See Vol. I., 3rd Series, p. 270, illustrated by Plate 11.)

from the Brazilian Government is for thirty years (to be increased to ninety), and the purchase money is to be £25,000, of which £20,000 will be taken in paid-up shares. Brazil and the countries of the River Plate at present obtain all the coal for their gas-works at a heavy cost from England, and the consumption is rapidly increasing.

Calow's Patent Safety Hoist.—The improved hoist, represented in the annexed engraving, is now being largely introduced into the mining and manufacturing districts by Messrs. Bailey & Co., of the Albion Works, Salford, who are, we believe, the sole makers of the apparatus. The apparatus was recently exhibited at the meeting of the Iron and Steel Institute at Middlesbro on Tees, where it attracted much attention. There are already twelve of these hoists at work at the eminent firm of Bolckow and Vaughan; and Messrs. Bell Brothers, another well-known firm in the North, have applied it to sixteen cages; and the Clay Cross Colliery Company to twenty. We are informed that its working has given great satisfaction, and that it has already saved lives and property on more than one occasion. The beauty of the invention consists in its simplicity. Practical engineers are well aware that the great objection to safety apparatus hitherto invented has been the great amount of friction and consequent destructive action. It is well known that every time a cage descends and ascends that the machinery is acted upon four times, which at modern collieries would amount to some thousands of times in a day, and this cannot take place without great care and expense. Mr. Calow has, it appears, overcome these objections, for his arrangement of mechanism is not brought into play by the mere slacking of the rope, but when the rope breaks only, the rope not being in any way connected to the apparatus. It may be asked, where then is the motion obtained? Any one who has studied the difference between a falling body and the same body being let down a shaft, at the greatest speed it is possible for an engine to accomplish, will have observed a great difference in their respective speeds; and it is in this difference in speeds wherein the motion is obtained, so that the cage has to gravitate before the machine is acted upon. It will be seen from the illustration that a bar has on it a weighted lever, and this weight compresses a spiral spring; when the cage becomes a falling body (i.e. falls at 16 feet in the first second) the support for the spring ceases, and it becomes of a greater length, thrusting the eccentric jaws or grips into the slides, and effectually preventing the cage descending.




Coal and Iron in the United States.—The quantity of iron made with bituminous coal in Pennsylvania in 1868 was 194,000 tons (in round figures), as compared with 191,072 tons in 1867. The production of iron made with anthracite coal in Pennsylvania last year amounted to 671,955 tons, as compared with 594,270 tons in 1867. The production of anthracite iron effected last year in Pennsylvania involved the consumption of 1,512,000 tons of coal. The production of rolled iron in Pennsylvania last year is computed to have been 520,000 tons, as compared with 490,081 tons in 1867. Railway iron figured in the total for 1868 to the extent of 276,500 tons, and in that of 1867 to the extent of 245,081 tons. In 1868 the rolling mills of Pennsylvania consumed 1,210,000 tons of coal, of which 380,000 tons were anthracite, and the remainder bituminous. It is curious to observe that, notwithstanding the great increase in the demand for railway iron in the United States since the close of the war, the native production does not appear to have been very materially extended.

Keys or Wedges for the Permanent-way of Railways, &c.—The improvements in keys or wedges illustrated in the accompanying engravings are the invention of M. Theodore Despain, of Paris, the chief objects in view being the securing of greater durability than is possessed by the ordinary wooden keys or wedges, with a better and more permanent tightening of the rail or other part to which the key or wedge is applied. M. Despain constructs his keys or wedges partly of metal (say cast-iron) and partly of wood, preferring such wood as has been previously treated with a view to its preservation. The main portion of the key or wedge is made of metal (*a* figs. 1 and 2), which receives the blows of the hammer when being driven, and this piece of metal is secured on one or both sides, or has an opening made through it, into which is inserted a facing or block of wood (*b*, figs. 1 and 2), the friction or holding surface or surfaces being of wood, whilst the body is of metal. The wooden portion should be rather shorter than the metal portion, in order that the hammer may not come in contact with and destroy the wood in the operation of driving. Figs. 3 and 4 show a modification of the same. Here the key or wedge is composed of a block of wood *e*, enclosed in a metal sheathing *f*, the metal extremities of which protect the wood from injury by the blows of the hammer.

Fig. 1. Fig. 3.

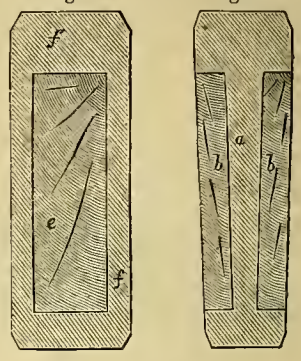
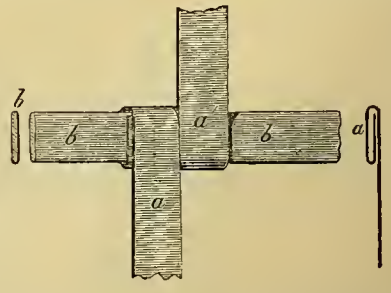


Fig. 2. Fig. 4.

Transit of Cattle by Rail.—Miss Burdett Coutts, acting upon a suggestion made by Mr. Reid, of Granton, near Edinburgh, has solved the question as to the best method of conveying cattle by rail. For some years Mr. Reid has devoted his attention to the improvement of the ordinary cattle truck; and Miss Coutts recently gave orders for the construction of ten of that gentleman's most recently patented cattle waggons. The improvements consist in the addition of a trough and hay-rack, which cross the waggon in the centre; the separation of the animals by wooden partitions; and protection from cold winds is ensured by the waggon being closed at the sides and top. Upon the roof is a water tank, from which the water flows into the trough. The cattle stand face to face; and there is room for six when the partitions are in their places, and for eight when they are removed. On Wednesday last Mr. Reid, by direction of Miss Coutts, purchased five black heifers in Edinburgh market for conveyance to London. These animals had been taken from grass, and conveyed in the usual cattle truck one hundred miles to Edinburgh. They were placed in Reid's truck at 4.30 p.m. on Saturday last, and left the Waverley Goods Station of the North British Railway at 8.30 p.m. the same night. At Carlisle the truck passed on to the Great Northern line; at Ingleton it was transferred to the Midland; and it reached London at 2.20 a.m. on Monday morning. The cattle never left the truck from 4.30 p.m. on Saturday, until 6.30 a.m. on Monday, when they were taken out and driven to the Islington Market. At starting there were forty-two gallons of water in the tank which is fitted to the truck, and the whole of it was consumed by seven o'clock on Sunday night, before reaching Trent. At that station twelve more gallons were run into the water trough, which were drunk before the train started. No more was given until reaching London, when the heifers drank about seven gallons. Of hay the animals ate nine and three quarter stones, ten stones having been placed in the rack at starting; and, in addition to the hay, three stones of oatmeal were consumed with the water. The cost of this food was 10*s.* for hay, and 6*s.* for oatmeal; and the fine appearance of the beasts was the subject of general comment in the market.

Riddle's Patent Hoop Joint.—A very simple and efficient arrangement of hoop joint has recently been patented by Mr. W. Riddle, of Lansdowne Terrace, Stockwell. It is more especially suited for hooping bales, but is susceptible of being applied to various other purposes. It simply consists in forming loops at the ends of the hoops which encircle the bale, and passing a stiff lath or spear (*b* in the engraving) through such loops. The ends of the hoops on a bale being brought side by side, and the spear or lath being passed through the folded ends or loops, when the pressure is released from the bale the hoops are not dependent on the elasticity of the bale for holding on to the spear, the inner fold (*a*) tightening on the spear with the strain. The spear should fit tolerably well. The patentee prefers to bend the hoop whilst the metal is red-hot.



## APPLICATIONS FOR
# PROVISIONAL PROTECTION FOR INVENTIONS
## UNDER THE PATENT LAW AMENDMENT ACT.

☞ When the city or town is not mentioned, London is to be understood.

*5th October* 1869.

2880 C. Montagu, Cannon Street—Umbrellas, parasols, and sunshades
2881 T. Atkinson, Hull—Apparatus for expressing oil, and for the manufacture of cake from the residue thereof
2882 W. Horsfall, New York, U.S.A.—Machinery for forging bolts, screws, and spikes
2883 J. N. Batey, Landport, Hants—Hemmers for sewing machines
2884 J. Winter, Wardour Street—Apparatus for filling glass bottles and jars with soups, jellies, fruits, and other edibles, for the purpose of preserving them with the said apparatus
2885 F. Hazeldine, Lant Street, Borough—Corkscrew
2886 W. Morris, Triangle, Halifax, York, and J. Teal, Sowerby, Halifax, York—Combing wool
2887 L. Byrne, Birmingham—Pump for domestic, horticultural, and other useful purposes
2888 H. Howard-Keeling, Rotherhithe—Manufacturing bars or links of wrought iron or other metal used in the construction of suspension or girder bridges &c.
2889 T. W. Bunning, Newcastle-upon-Tyne, and W. Cochrane, Coxlodge, Northumberland—Apparatus used in getting coal, stone &c.
2890 J. Kircher, Cannstadt, and E. Ebner, Stuttgard, Wurtemberg—Black printing ink capable of being removed from paper
2891 J. Kircher, Cannstadt, and E. Ebner, Stuttgard, Wurtemberg—Removing print from paper
2892 E. Smethurst, Stockport, Cheshire—Funnels or funnel measures
2893 T. Adams, Penge, Surrey—Slide valves and pistons of steam and other engines
2894 J. Clayton, Preston—Construction of boilers for generating steam
2895 W. Richardson, Oldham—Machinery for burring or cleaning wool, cotton &c.
2896 C. E. Spooner, Bron-y-Garth, Port Madoc—Machinery for bending rails or bars

*6th October* 1869.

2897 S. Farron, Ashton-under-Lyne—Cocks or taps
2898 E. Wigzell and J. Pollit, Sowerby Bridge—Metallic pistons for steam engines
2899 W. A. Whitty, Strand—Advertising medium
2900 J. W. Powell, Bermondsey—Valve cock
2901 B. Hunt, Serle Street—Decoration or ornamentation of metals.—A com.
2902 H. and A. Holmes, Derby—Axletrees
2903 W. R. Lake, Southampton Buildings—Permanent way of railways.—A com.
2904 E. Russ, and H. and E. Hammond, Winchester—Breech-loading firearms
2905 T. F. Newell, Cloak Lane—Rag engines.—A com.
2906 E. A. Pontifex, Shoe Lane—Refrigerators
2907 E. Tyre, Old Jewry Chambers—Electro-magnetic telegraphic apparatus for train signalling on railways
2908 W. H. Horsley, Hull—Washing machines.—A com.
2909 E. B. de Léon, Bordeaux—Printing without heat upon wood used for cases, bars, or heads of casks &c.
2910 W. E. Newton, Chancery Lane—Permanent way of railways and tramways—A com.
2911 J. F. M. Pollock, Leeds—Machinery for making bricks &c.

*7th October* 1869.

2912 J. McKenzie, Glasgow, N.B.—Jointing, fastening, and securing rails in railway chairs
2913 A. Coleman, St. Mary-at-Hill, and W. Coleman, Whitefield, Heaton Norris—Latches or locks applicable especially to railway carriage doors
2914 J. C. Ramsden, Bradford—Looms
2915 H. Schildberg, Westminster Chambers—Signalling apparatus.—A com.
2916 W. E. Newton, Chancery Lane—Wheel for propelling ships &c.—A com.
2917 W. P. Gregg, Boston, U.S.A.—Parlor or roller skates

*8th October* 1869.

2918 R. Chapman, Shrewsbury—Railway fish-plates and chairs
2919 D. Parrish, Threadneedle Street—Axle-boxes.—Partly a com.
2920 J. Hilton, Farnworth—Casting socket and flanged pipes
2921 J. Duckworth, T. Hindle, and B. Jerram, Liverpool—Construction of concrete and cement buildings, structures &c.
2922 G. W. Hawksley and M. Wild, Sheffield—Steam boilers
2923 W. R. Lake, Southampton Buildings—Pedals and damping apparatus for pianofortes &c.—A com.
2924 T. Rice, Bath Street, City Road—Fixing door knobs or handles on to the spindles of door locks
2925 A. Etienne, Charlotte Street, Fitzroy Square—Carriages, vehicles, and velocipedes
2926 O. C. Evans, Bermondsey—Wheels
2927 N. Wilson, High Holborn, and W. Campion, Nottingham—Sewing machines
2928 H. Wainwright, New York, U.S.A.—Distilling and producing fresh potable water
2929 J. Frearson, Birmingham—Water tuyeres for forges and furnaces
2930 J. Wallace, East Belfast—The distilling of alcoholic liquors
2931 W. J. Jones, King Street, Cheapside—Hot-water boilers

*9th October* 1869.

2932 C. E. Brooman, Fleet Street—Measuring the flow of liquids.—A com.
2933 J. Chandler, Mile End Road—Preventing waste of water from pipes, mains, cisterns &c.
2934 J. More, Lee, Kent—Preparation of oils for painting
2935 R. L. Hickes, Liverpool Street—Applying electricity to obtain motive power
2936 W. Kelsey, Cannon Street—Driving drums or pulleys and railway wheels
2937 D. Sowden, R. C. Stephenson, and J. Myers, Bradford—Looms
2938 B. Baugh and B. Walters, Birmingham—Ornamenting bricks, building-blocks, and roofing and other tiles
2939 J. H. Johnson, Lincoln's Inn Fields—Nail-making machines.—A com.
2940 H. Reid, Herne Bay—Treatment and preparation of clays for the manufacture of Portland and other cements
2941 W. N. Hartley, Litchfield—Whitening or bleaching yarns, fabrics &c.
2942 A. H. Brandon, Paris—Summer skate.—A com.
2943 E. H. C. Monckton, Threadneedle Street—Railways &c.
2944 E. H. C. Monckton, Threadneedle Street—Guns, cartridges, and projectiles
2945 A. M. Clark, Chancery Lane—High and low water level indicators for steam boilers.—A com.
2946 W. C. May, Stratford, Essex—Non-oleaginous printing inks and varnishes
2947 C. Wyndham, Southover, near Lewes—Velocipedes
2948 J. H. W. Biggs, Manchester—Joining warp ends
2949 A. Welch, Southall, Middlesex—Cattle trucks

*11th October* 1869.

2950 A. C. Kirk, Glasgow, N.B.—Treating mineral oils
2951 G. A. Middlemiss, Sunderland—Withdrawing water or other fluids in as pure a condition as possible from wells, cisterns &c.
2952 J. Hugget, Eastbourne, and J. A. Hugget, Clapham—Manufacture of nails
2953 E. A. Cowper, Great George Street—Treating cast iron for the production of wrought iron and steel therefrom
2954 A. V. Newton, Chancery Lane—Manufacturing paper-hangings.—A com.
2955 T. Greenwood, Leeds, and J. Keats, Leek, Stafford—Manufacture of boots and shoes
2956 W. R. Lake, Southampton Buildings—Land cultivators.—A com.
2957 W. R. Lake, Southampton Buildings—Permanent way of railways.—A com.

*12th October* 1869.

2958 A. B. Childs, Mark Lane—Reducing wood to a fibrous condition for the manufacture of paper stuff or pulp
2959 E. A. Snuggs, Windsor—Cocks, taps, and valves
2960 R. L. Hattersley and J. Hill, Keighley, York—Looms
2961 T. Cope, J. Hignett, and C. Lander, Liverpool—Twisting or spinning tobacco
2962 J. B. Blythe, London Street—Vaporising and burning liquid hydrocarbons for the production of heat in furnaces and for generating steam
2963 M. Andrew, Melbourne, Victoria—Locks and latches
2964 W. Bennett, Aston, near Birmingham, and J. Currall, Birmingham—Kitchen ranges
2965 E. Farrington, Paris—Breech-loading firearms
2966 E. Brown, Lyme Regis—Propelling carriages, boats, and other vehicles by the hands or feet
2967 J. Morrison and J. Thomas, Ferry Hill Iron Works, Durham—Fire-place and grate of puddling furnaces &c.
2968 T. Stevenson, Edinburgh—Iron girders
2969 W. Lincolne, Glasgow, N.B.—Fastening or securing the joints of belts.—A com.

*13th October* 1869.

2970 J. H. Selwyn, Grasmere, Westmorland—Firearms
2971 J. Halford, Kingswinford, Stafford—Puddling furnaces
2972 L. M. Casella, Hatton Garden—Apparatus to be employed in lighting gas burners, lamps &c.
2973 J. Smith, Cockspur Street—Instruments for timing ships' logs
2974 J. Kennedy, Westminster—Sanitary composition or cement
2975 R. Scholefield, Leeds—Pumps
2976 T. Parry, Balham, and J. McHardy, Edinburgh, N.B.—Drag applicable to wagons, omnibuses &c.
2977 S. Osborn, Sheffield—Knife bars and knives for reaping and mowing machines
2978 W. Challiner, Crimesthorpe, Sheffield—Manufacture of forks and spoons
2979 C. Brakell, Oldham—Fans, pumps, and machinery for propelling air, fluids, and other substances by centrifugal force
2980 J. Hartley, Leeds—Registering billiards &c.
2981 R. J. Ellis, Liverpool—Desiccating animal and vegetable matters

*14th October* 1869.

2982 W. J. Bonser, Highbury New Park—Feeding and watering cattle in railway truck
2983 W. E. Cedge, Wellington Street, Strand—Putting up or incasing packets of needles.—A com.
2984 J. H. Roberts and E. Simons, Manchester—Breaks for railway carriages
2985 B. Calvert, Bolton—Cleaning hose pipe
2986 F. M. Cotton, Brompton, and W. Field, Lower Tooting—Facilitating the copying of drawings &c.
2987 S. Wilson, Manchester—Applying power to the knee-joint levers of certain presses used in pressing cotton
2988 C. W. Siemens, Great George Street—Smelting iron and steel
2989 L. A. Lesage, Paris—Closing and securing vessels containing alimentary substances
2990 E. Lane, Paddington—Permanent way of railways
2991 C. L. Page, Pall Mall—Packing-cases or boxes for containing bottles &c.
2992 J. Hudson, J. Hudson, jun., and C. Hudson, Newcastle-upon-Tyne—Manufacture of paper
2293 W. Kloen, Birmingham—Water-colour printing
2994 E. L. Parker, Birmingham—Combined pocket corkscrew and carriage key
2995 J. Taft and J. C. Edwards, Manchester—Opening, cleaning, and preparing cotton &c.
2996 W. Barbour, Glasgow, N.B.—Stage lights
2997 N. Washburn, Massachusetts, U.S.A.—Railway carriage wheels.—A com.
2998 W. Avery and A. Fenton, Redditch—Cases or receptacles for needles, pins, matches, pens, cards, stamps, photographs, cotton &c.
2999 E. Roe, Nottingham—Manufacture of looped or knitted fabrics, and also of warp and wet fabrics

*15th October* 1869.

3000 G. W. Rowley, Addle Street—Ladies' and children's combined under garment
3001 D. Brown, Clerkenwell Green—Treating iron and other metal surfaces, so as to render the same better adapted to advertising and other purposes
3002 L. Byrne and W. Payne, Birmingham—Packing applicable for buckets, pistons, and stuffing-boxes
3003 J. Mackie, Saint James' Street, Westminster—Lock-fast breech-loading firearms
3004 W. R. Lake, Southampton Buildings—Machine for drilling or boring rocks.—A com.
3005 W. R. Lake, Southampton Buildings—Sewing machines.—A com.
3006 W. R. Lake, Southampton Buildings—Chain cable stoppers.—A com.
3007 S. Barber, Liverpool—Propulsion and steering of navigable vessels
3008 J. Walker, Glasgow, N.B.—Apparatus for measuring fluids
3009 J. W. Robinson and T. Murray, Glasgow, N.B.—Burning of liquid carbons, as the tarry residues left in the refining of mineral oils, as a fuel in furnaces
3010 E. T. Hughes, Chancery Lane—Regulating or controlling the delivery of tickets at railway stations &c.—A com.
3011 E. T. Hughes, Chancery Lane—Lift for raising and lowering merchandise &c.—A com.
3012 W. B. Leachman and J. Holroyd, Leeds—Hydraulic apparatus for raising and forcing water
3013 H. Smith, Henrietta Street—Dish covers
3014 J. H. Lyon, Sutton, Lancaster, and W. Lyon, Runcorn, Chester—Furnaces for making glass
3015 W. E. Cedge, Wellington Street, Strand—Elastic horse-shoe.—A com.
3016 A. H. Donché, Paris—Regulating the supply of water to turbines and hydraulic wheels
3017 H. M. Marsden, Sheffield—Sheep shears &c.

*16th October* 1869.

3018 J. Horton, Milverton, near Leamington—Castors for furniture
3019 F. P. Whitehurst, Putney—Mashing grain and obtaining products therefrom
3020 J. Willats, Kingsland Road—Playing cards
3021 J. J. Nancy, Hatton Garden—Supplying thread to sewing and embroidering machines.—A com.
3022 A. Angell, Rio de Janeiro, and J. J. Perry, Red Lion Square—Apparatus for heating and delivering metal bars.—A com.
3023 W. H. H. McNeight, Dublin, Ireland—Venetian and other blinds
3024 J. Raper, Dudley Hill, Bradford, M. Pearson and D. Mills, Bradford—Looms
3025 J. Player, Philadelphia, U.S.A.—Manufacture of iron and steel

*18th October* 1869.

3026 W. Rogers and G. Tidcombe, jun., Watford—Balls and mallets used in the game of croquet &c.
3027 N. Hodgson, New Barnet—Motive-power engine
3028 J. M. A. Stroh, Tolmers Square, Hampstead Road—Electro-magnetic clocks
3029 G. Collins, Preston—Carding engines
3030 J. C. Martin, Gray's Inn-Road—Iron or other metal name plates for shop window stall plates, door plates &c.
3031 J. and W. Bottomley, Bramley, near Leeds—Machinery for fulling or milling woollen and other woven or felted fabrics
3032 J. and W. Bottomley, Bramley, near Leeds—Machinery for washing and scouring woollen and other woven or felted fabrics
3033 P. Jacques, Paris—Purifying and decolouring blood-albumen
3034 C. and W. Bradley, and E. Tbackray, Bradford—Wool combing machinery
3035 R. S. Bartleet, Redditeb—Cases for the holding of needles &c.—A com.
3036 A. P. Price, Lincoln's Inn Fields—Purification of coal gas.—A com.
3037 M. Ker, Mansfield Road—Hanging and drawing window and other curtains
3038 C. E. Spagnoletti, Paddington—Apparatus for signalling by means of electricity
3039 A. Welcb, Southall—Cattle trucks
3040 A. V. Newton, Chancery Lane—Fabrics to be used as a sacking for bedsteads and couches, and frames for supporting the same at tension.—A com.
3041 W. R. Lake, Southampton Buildings—Nnt for screw bolts.—A com.

*19th October* 1869.

3042 J. and J. Kippax, Bolton-le-Moors—Weaving counterpanes or quilts
3043 M. Henry, Fleet Street—Construction of bridges.—A com.
3044 A. Forder, Wolverhamptou—Seats or saddles of velocipedes &c.
3045 A. Evans, Grimsbury—Joining or connecting pipes and tubes
3046 W. B. Robins, Shepherd's Bush—Syringes and other apparatus for throwing water
3047 A. Clegg, Finsbury Place—Sewing machines
3048 J. H. Johnson, Lincoln's Inn Fields—Improvements in heating and in apparatus employed therein.—A com.
3049 F. R. Window, Baker Street, Portman Square—Producing photographs in pigments

*20th October* 1869.

3050 J. Hudson, Fleetwood, Lancaster—Machinery for opening and closing the gates of railway crossings
3051 D. Jackson and J. Riley, Oldham, and G. R. Ray, Dukinfield—Machinery for cutting, shaping, and dressing stone
3052 W. R. Thomson, Glasgow, N.B.—Locks, latches, or bolts for fastening the doors of railway carriages
3053 A. Munro, Arbroath, N.B., and W. B. Adamson, Glasgow, N.B.—Cutlery, edge tools, agricultural and other implements
3054 J. Scharr, Stuttgard, Wurtemburg—Manufacture of liquid soap
3055 B. Sulman and R. Willis, City Road—A quadrantal-action lever stamping and cancelling press
3056 W. Heywood and J. Bottomley, Huddersfield—Carriages
3057 J. F. Crease, Eastney, Southampton—Attaching Roman, Portland, or other like cements to iron or other substances
3058 A. Brady, Stratford—Purifying iron &c.—A com.
3059 W. Firtb, Edinburgh—Wheels of traction carriages for use on common roads and tramways
3060 J. Howard and E. T. Bousfield, Bedford—Steam boilers
3061 W. E. Newton, Chancery Lane—Preserving animal or vegetable substances from decay.—A com.
3062 H. Percival, Sunderland—Glass furnaces

*21st October* 1869.

3063 S. H. Musgrave, Camden Road—Manufacture of needle and other cases from opaque glass tubing of various colours
3064 H. Brooks, Cumberland Market—Metallic cap or cover to glass or other bottles or vessels
3065 J. Becker, Paris—Apparatus for stopping bottles
3066 G. M. Ashfortb, Market Overtou, and W. Hardy, Thistleton, Rutland—Obtaining and applying motive-power applicable to working sewing machines &c.
3067 W. R. Lake, Southampton Buildings—Rotary blowing engines.—A com.
3068 G. Clark, Hampstead—Hansom cabs
3069 G. Dauzats, Paris—Coloured or illustrated dominoes with central number
3070 J. Buchanan, Gateshead-on-Tyne—Apparatus for coiling electric telegraph cables or ropes
3071 F. Jenkin, Edinburgh—Bridges
3072 A. M. Clark, Chancery Lane—Hinges and hinge guards for railway carriage and other doors.—A com.

*22nd October* 1869.

3073 R. J. Goodbody, Tullamore, Ireland, and R. E. Donovan, Upper Rathmines, Ireland—Apparatus for roasting tobacco for snuff
3074 T. Gibb and C. Gelstharp, Jarrow-on-Tyne—Furnaces for calcining ores &c.
3075 H. A. Bonneville, Paris—Sewing machines.—A com.
3076 J. R. Grayson, Princes Square, Bayswater—Apparatus for clipping or shearing horses &c.
3077 C. E. Fuller, Sambrook Court—Machines for manufacturing brushes.—A com.
3078 J. Rignall, Bury Saint Edmunds—Reaping machines
3079 W. J. Rivington, Clerkenwell—Counting and registering apparatus

*23rd October* 1869.

3080 C. D. Abel, Southampton Buildings—Metallic tiles or slates.—A com.
3081 C. A. Ofverberg, Finsbury—Filters.—A com.
3082 F. Woodward, Worcester—Apparatus for signalling and communicating on railway trains
3083 J. Cash and J. Cash, jun., Coventry—Boxes or cases for preserving letters, papers &c.
3084 R. Scott and W. McIvor, Addiewell, Midlothian, N.B.—A process whereby the sulphuric acid residues produced in the refining of oleaginous and bituminous matters may be utilised and employed for the production of sulphate of soda and sulphide of sodium and black ash
3085 F. S. Anderson, New Orleans, U.S.A.—Obtaining fuel and light from water
3086 T. Deichmann, Cologne—Preserving meat.—A com.
3087 T. Hydes, J. Bennett, and J. E. Bennett, Sheffield—Propelling ships
3088 A. B. Ibbotson and T. S. Sarney, Sheffield—Metallic keys or wedges for supporting and securing railway rails in their chairs
3089 T. Bevington and S. Courtauld, Spa Road, Bermondsey, and J. A. Norberg, Almorah Road, Islington—Machinery for breaking stone and ore
3090 L. Meurin, Bombay—Clocks &c.

*25th October* 1869.

3091 P. Walker, Bewsey New Hall, near Warrington—Rendering coal mines less injurious to those employed therein
3092 W. R. Lake, Southampton Buildings—Sewing machine needles.—A com.
3093 W. R. Lake, Southampton Buildings—Manufacture of dry white-lead and white-lead pigment from metallic lead.—A com.
3094 W. W. Ladelle, Wraysbury, Buckingham—Bleaching
3095 J. H. Johnson, Lincoln's Inn Fields—Adhesive compound, and its application to stamps, labels, wrappers, envelopes &c.—A com.
3096 G. Ireland, Handsworth, Stafford—Nut-crackers
3097 J. Edge, Madeley, Salop—Flat wire rope

*26th October* 1869.

3098 J. Lockwood, Leeds—Couplings for railway engines, carriages &c.
3099 W. B. Haigh, Oldham—Circular saw benches
3100 J. S. Grierson and R. Philips, Edinburgh, N.B.—Apparatus for bronzing, colouring, and illuminating cards and paper
3101 T. Hoey, Glasgow, N.B.—Places for dwellings
3102 D. Spill, Hackney—Preparation and use of solvents of xyloidine
3103 J. P. Rennoldson, South Shields—Steam lubricators
3104 J. Dodge, Manchester—Apparatus for forging or shaping metals
3105 J. H. Nutt, Kingston-upon-Hull—Envelopes used in hydraulic and other presses
3106 J. Sheldon, New Haven, Connecticut, U.S.A.—Machinery for manufacturing brushes.—A com.

*27th October* 1869.

3107 T. Briggs, Manchester—Manufacture of materials used for packing &c.
3108 T. Dunn, Pendleton—Locomotive steam engines and railway carriages
3109 C. Simpson, Mount Street—Miniature or toy bricks
3110 W. A. Martin and E. Wylam, Fleet Street—Fuel-feeding and smoke-consuming apparatus for furnaces
3111 A. Bowater, Sheffield—Machine for rolling or shaping metals
3112 J. Holding and J. Eccles, Manchester—Looms
3113 W. Llewellyn, Bristol—Armour plating ships
3114 J. Wakefield, Birmingham—Manufacture of carriage and other bolts and pins
3115 O. L. Hopson, Waterbury, Connecticut, U.S.A.—Apparatus for reducing the diameter of wire or rods for wire drawing.—A com.
3116 T. Clark, Cheapside—Implements adapted for constructing tube wells and driving hollow piles
3117 H. A. Bonneville, Paris—Box for enclosing portraits and photographic cartes.—A com.
3118 W. R. Lake, Southampton Buildings—Manufacture of sheet iron.—A com.
3119 W. A. Ross—Preserving the surface of iron, steel, copper, brass &c.
3120 J. B. Elkington, Birmingham—Manufacture of copper

*28th October* 1869.

3121 H. B. Barlow, Manchester—Knitting machines.—A com.
3122 R. Ventress, Stockton-on-Tees—Saws
3123 J. Watson, Glasgow, N.B.—Presses for compressing cotton, jute &c.
3124 S. Bennett, Dalston—Obtaining valuable products from the waste liquors run off from tanneries
3125 W. Brookes, Chancery Lane—Electro-deposition of nickel.—A com.
3126 J. W. More, Finsbury, and J. Norman, Hoxton Square—Apparatus for clipping horses
3127 G. Tubbs, Goodge Street—Turn buckles for cupboard and other doors
3128 L. P. Muirhead, Leadenhall Street—Apparatus for raising sunken ships &c.
3129 F. Taylor, Romsey, Southampton—Apparatus for receiving, drying, and deodorising human excrement
3130 N. R. Vail, Brixton—Axles for rail and tramway carriages and vehicles.—A com.
3131 W. E. Newton, Chancery Lane—Drawing frames.—A com.
3132 S. C. Salisbury, New York, U.S.A.—Steam boilers and generators
3133 M. Clemens, Boston—U.S.A.—Shaft coupling

*29th October* 1869.

3134 J. James, Princes Street, Stamford Street—Apparatus for bending and jointing metallic or other sheets, so as to form boxes, cans &c.
3135 A. Knowles, Pendlebury—Apparatus for cutting and getting coal
3136 W. W. Girdwood, Bromley—Gland packing
3137 W. R. Lake, Southampton Buildings—Volute springs.—A com.
3138 T. Taylor and J. W. Davies, Manchester—Apparatus for singeing horses
3139 J. A. Miller, Boston, U.S.A.—Steam generators and surface condensers
3140 C. D. Abel, Southampton Buildings—Apparatus for moulding and casting metal columns.—A com.
3141 M., L., and E. Darnbrough, Dewsbury—Lubricators for steam engines, cylinders &c.
3142 A. Nairn, Leith, N.B.—Steam carriages for common roads
3143 G. Burge, jun., Rochester—Cement
3144 B. J. B. Mills, Southampton Buildings—Manufacturing cigars.—A com.
3145 J. H. Spencer, Aston, near Birmingham—Compound for lubricating

*30th October* 1869.

3146 R. J. Everett, West Ham—Manufacture of salts of ammonia from ammoniacal gas liquor
3147 E. H. C. Monckton, Threadneedle Street—Electricity and means of telegraphing
3148 J. Elce, Manchester, and W. J. Gradwell, Longsight, near Manchester—Machinery for spinning and doubling
3149 O. Fahnehjelm, Stockholm—Cooking apparatus.—A com.
3150 C. Sacrè, Manchester, S. Perkins and W. Smellie, Gorton—Manufacture of wrought iron or malleable metal of steely quality
3151 J. C. Mewburn, Fleet Street—Photographic process for preparing printing surfaces.—A com.
3152 J. C. Meyburn, Fleet Street—Apparatus for feeding boilers, and for raising and forcing fluids generally.—A com.
3153 W. E. Gedge, Wellington Street, Strand—Welding iron or any other metal.—A com.
3154 L. Wray, Ramsgate—Motive-power engines
3155 A. P. Wright, Brixton—Machinery for breaking, softening, and preparing flax &c.—A com.
3156 R. Marsden, Sheffield—Pulley blocks or apparatus for raising heavy weights
3157 T. Moore, South Stockton-on-Tees, and C. A. Head, Stockton-on-Tees—Apparatus for raising and lowering weights
3158 W. B. Espeut, Southwick Street—Centrifugal drying machines
3159 A. Minton, Kossuth Terrace, Victoria Park Station—Electro-coating iron and other metals

*1st November* 1869.

3160 E. de Lagillardaie, Lorient, France—Construction of suction siphons for raising liquids and producing condensations and evaporations in vacuum
3161 W. R. Watson and R. Murray, Glasgow, N.B.—Machinery for doubling yarns or threads
3162 B. Bianchi, Paris—Manufacture of cartridges suitable for mining and general purposes
3163 J. Dewar, Kirkcaldy, N.B.—Treatment and application of paper waste
3164 J. Dewar, Kirkcaldy, N.B.—Artificial fuel
3165 E. Ford, Oakley Street, Chelsea—Chromatic slides for cornets, trumpets, trombones &c.
3166 R. C. Addy, Lisburn, Ireland—Spindles or flyers used for preparing and spinning flax, cotton, silk, wool &c.
3167 J. Hargreaves and T. Robinson, Widnes—Treatment of pyrites
3168 A. Thornton, Cleckheaton, and B. Senior, Heckmondwike—Carding engines
3169 W. Birch, Salford—Sewing machines
3170 W. and J. Jackson, Halifax, and J. Cowgill, Bradford—Preventing the escape of smoke from steam boiler and other furnaces
3171 P. Jensen, Chiswell Street—Guns for bayonet drill.—A com.
3172 B. Tower, Moreton, near Ongar, Essex—Hot-air engines

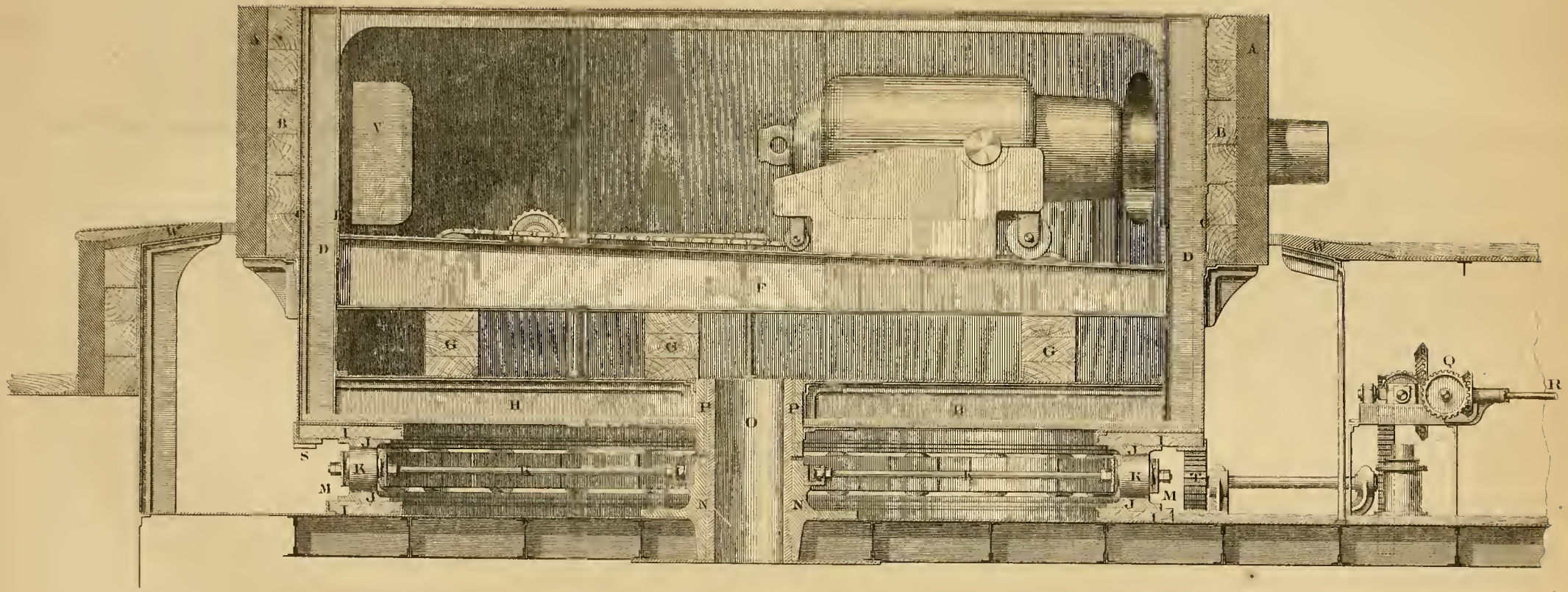
JANUARY 1870.
Practical Mechanics Journal.
PLATE XIII.

# MONITOR TURRET,

## WITH WORKING MACHINERY AS FITTED IN THE

# ROYAL NAVY.

Third Series
VOL. 5.



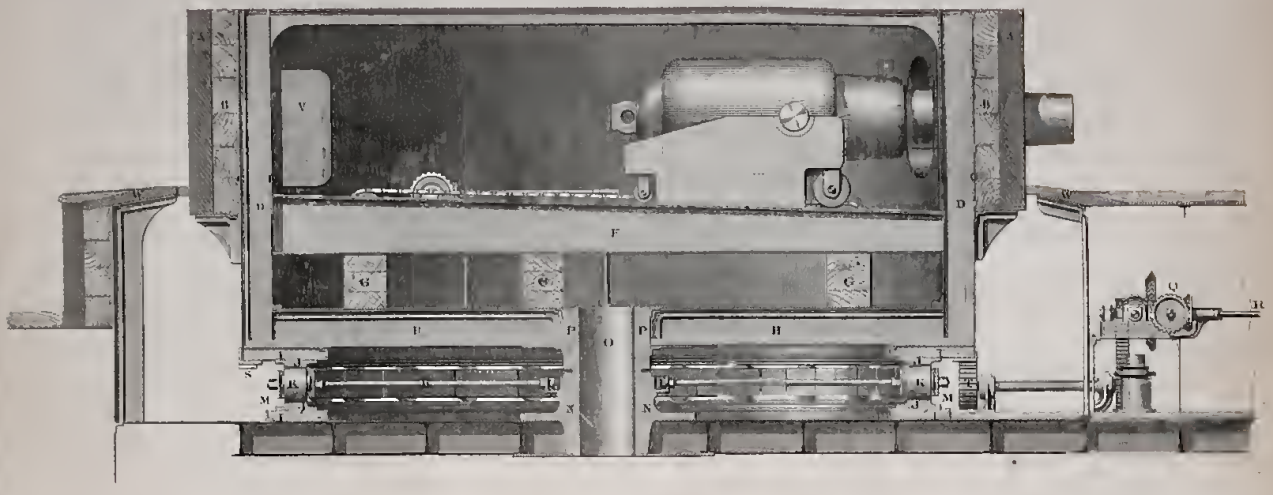

SCALE.

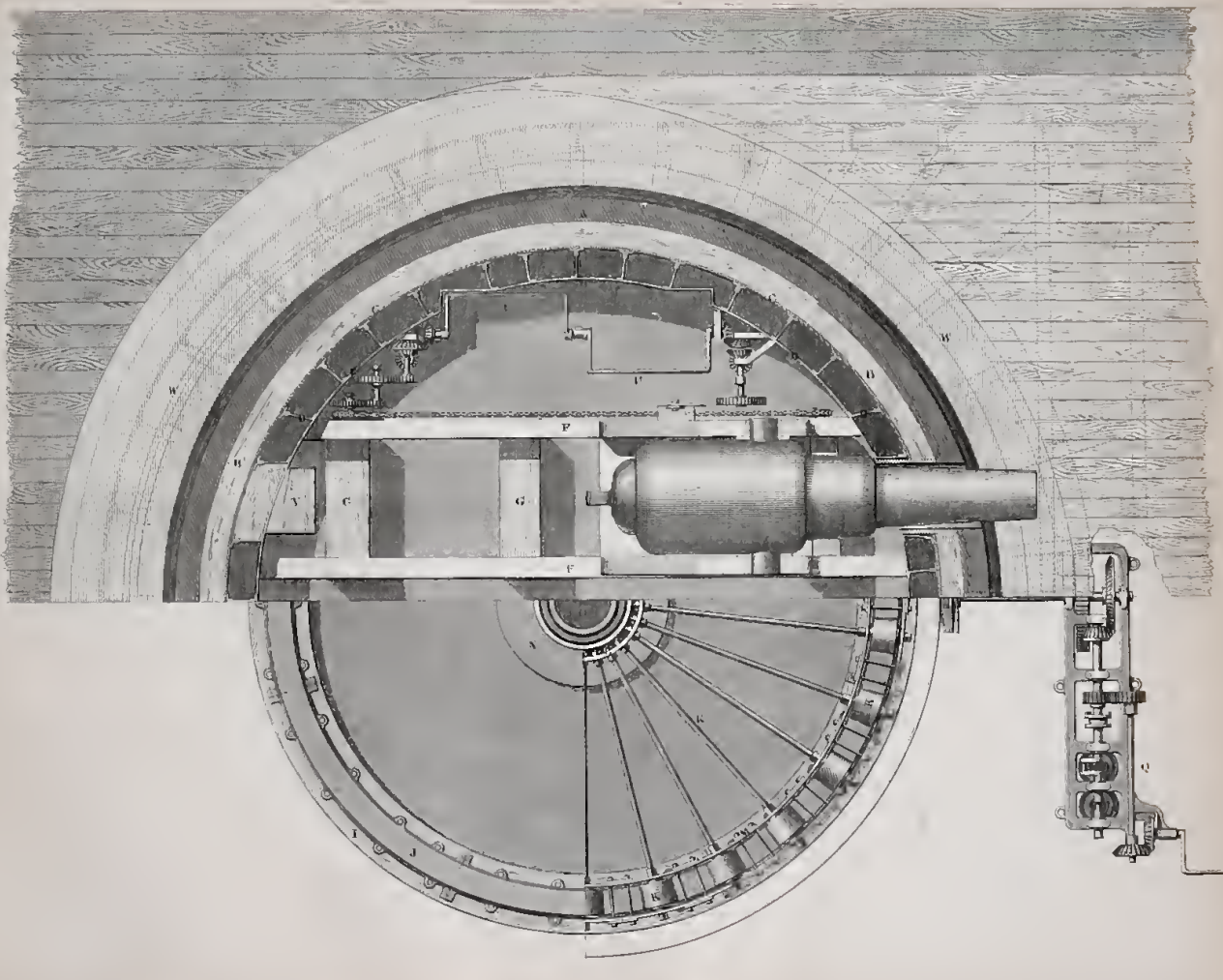
# MONITOR TURRET,

WITH WORKING MACHINERY AS FITTED IN THE

# ROYAL NAVY.







SCALE

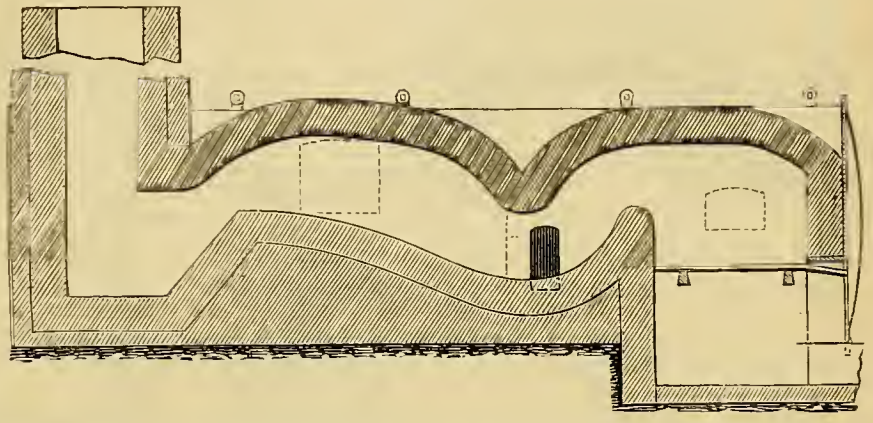
0 1 2 3 4 5 10 15 20 FEET

## ON SOME POINTS OF PRACTICE IN IRON FOUNDING. NO. XLI.

*Air Furnaces—concluded.*

We have said that the founder who is about to construct an air furnace for the first time, will be wise to follow precedent as regards its proportions, and it follows that good examples are of importance. We therefore now present illustrations of some of the best air furnaces of Woolwich Arsenal. Figs. 1 to 6 represent reverberatories so proportioned that they are applicable either to the fusion of cast-iron or of bronze or brass. For the latter uses, a furnace capable of receiving tolerably large pieces, such as condemned bronze guns or mortars—or lumps of broken up stern frames or propellers &c., is needed, and the furnace figs. 1 and 2 is constructed with this view, the large charging door shown in longitudinal and in horizontal sections next the chimney stalk being intended for such charging in gross pieces. There are two apertures at different levels into the sole or "sumph"—the higher one for stirring and skimming the fused metal—the lower one for tapping it out by. This furnace, to the scale of the illustration, was capable of melting two tons of bronze—or nearly as much cast iron; it would bear enlarging, the form remaining similar, so as to melt four tons.

Fig. 1.



Figs. 3, 4, 5, and 6 show in longitudinal and horizontal and transverse sections another furnace, equally capable of being employed on iron or bronze, but in reality used for the latter—for which its short flame-bed is well calculated to prevent loss by slow oxidation—though not so to avoid waste of fuel. The form of the bridge in this furnace, as seen best in transverse section at C D, is somewhat peculiar, and, we should expect, advantageous, as causing the flame to converge on all sides over the sole. Another peculiarity of this furnace is that the fuel is fed in upon the grate bars from above, in place of at the side. A movable hopper, however, into which the charge of fuel could be put, and at once discharged into the fire, without admitting any cold air, in place of the fire-tile sliding door shown in the figure (longitudinal section) would be an improvement. The flue of this furnace, owing to local circumstances, ran for some distance horizontally before reaching the chimney stalk. This was also a two-ton furnace, but admits of being lineally enlarged by scale, so as to melt double that weight of iron or bronze—for the former purpose we do not advise these short-bedded furnaces—which waste fuel very much. Figs. 7 and 8 may be taken as the best type of heavy cast-iron melting reverberatory, with this exception, that we should prefer at least one-half a greater width of interior or flue at the deepest part or pool next the chimney, where, in our judgment, this furnace was far too much contracted. It would no doubt give very hot metal, but it not only loses capacity by this narrowness, but would probably be found to yield iron with a good deal more oxide and scoria than need be.

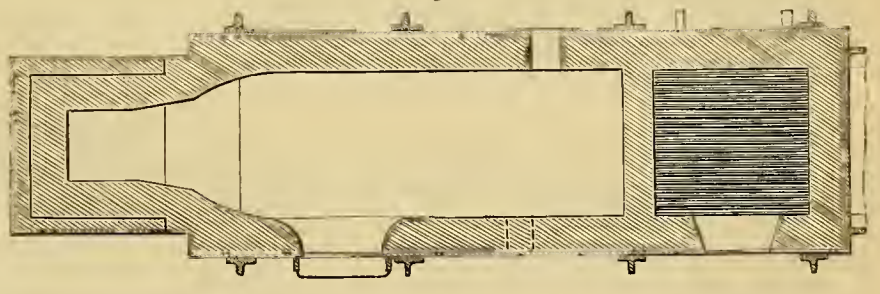
This furnace, with its wide charging door and broad sole next the bridge, was capable of taking in the heaviest lumps of broken-up guns, and we understand was employed with satisfactory results in the cast-iron gun foundries under Colonel Wilmot, R.A., just before the Crimean war and before those splendid foundries were so injudiciously broken up to be converted into wrought iron gun factories. As drawn to scale, it would melt upwards of five tons, but might be lineally enlarged so as to be competent to yield ten tons of liquid iron. In this instance it will be seen that the chimney-stalk is borne independently upon four cast-iron columns, so that the furnace can expand and contract, or may be taken down and rebuilt without disturbing the chimney.

The air drafts (of cold air) in all these furnaces come from without the foundry, and such is best and most convenient for the furnace man, where the furnace is supplied with cold air; but wherever air furnaces are employed continuously, we should use up the enormous amount of waste heat, to heat up the air for the supply of the fire, either by hot air pipes, placed in a suitable way in the chimney-stalk, or an enlargement of it, or on the regenerative plan of Mr. Siemens. It will be observed that these furnaces are built wholly within a casing of heavy cast-iron sustaining plates, connected by cross tye bolts above, and dipping at their lower edges into the foundations. This is far better and safer than the cheaper plan of intermittent cast-iron vertical bars with ribs, leaving naked brickwork between and connected by cross tyes. Besides the evil that these all bend and distort more or less, there is this subsidiary advantage in the continuous plates, that they prevent all indrafts of cold air through chinks and expanded open joints in the red-hot furnace walls. The fire bars of all these furnaces are of plain square bar iron.

In the last example, figs. 7 and 8, the fire is fed from a large dead plate in front of the feeding aperture, which was kept heaped up with coal so as to exclude air, the coal being now and then pushed on to the grate with a slice or fire rake. In the building of furnaces such as these, the choice of the very finest materials will be found good economy in the end.

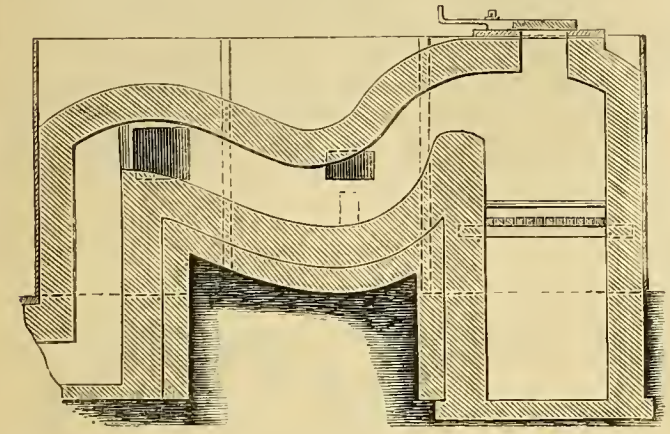
Grüner and other metallurgists have shown to how great an extent the chemical constitution of the cast-iron fused and kept for some time in a furnace, may be influenced, other conditions being the same, by the reaction of the materials of the furnace lining, according as the fused portions melted away from this produce, with the oxides and other matters emanating from the cast-iron itself, a basic or a non-basic—or very silicic slag. This affords one ground for choice in determining along with as great infusibility as possible, the chemical nature of the fire brick, blocks and clays we shall employ. But permanence and durability as against melting is the paramount consideration. The strains brought upon the bricks and especially the large "blocks" of the arches and counter arches of a large furnace in work are enormous, both by change of volume, and by abnormal resulting strains, as well as by fluid pressure, &c. The covering arches of furnaces, constructed badly or built of tender materials, have been known to come down without a moment's warning, with a charge of metal nearly all melted in the

Fig. 2.



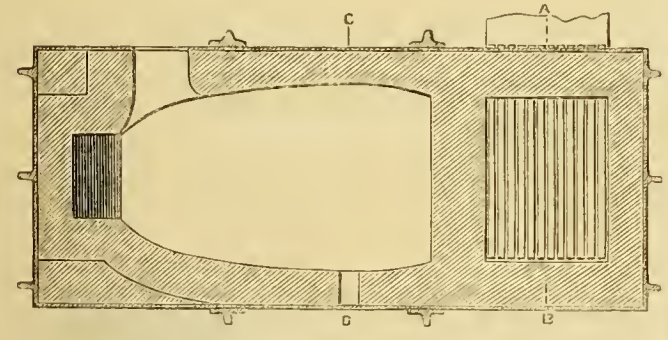
body of the furnaco, aud a vast mass of incandescent fuel alight. Such an accideut not only endangers all around, and results in a very serious immediate loss, but may endanger the destruction of a timber-roofed foundry; so that no precaution, so far as foresight and the use of the best materials can go, is misplaced here. The older practice was always to "tap out" the contents of the

Fig. 3.



air-furnace into a "sand pool," whence, after skimming by passing under a "loamed" "dam plate," the purc metal ran into the mould. If thc sole of the furnace be of a proper size, and the furnace management be as it ought however, "a pool" is perfectly useless and even injurious. The metal should reach its best state and temperature in the furnace, and bc at once tapped out to run in loamed shoots of thin plate iron, into the mould, being skimmed on its way, not only by the "dam plate" but by three or four "hand skimmers" stationed along the line of its flow.

Fig. 4.




In the working of air-furnaces it is not uncommou to make one furnace-man (with labourers to assist him) attend to three or four furnaces at once. We deem such a discipline bad. The skill and practice of the furnace fire-man go for far more, than those without experience would probably belicve, in the successful management of the melting. One man, especially "if he knows his furnace," will melt with a large economy of coal as compared with another; but to effect this, or indeed to work an air-furnace of large size properly at all, requires on the part of the furnace-man the most incessaut watchfulness and diligent care; to remit this for ten minutes may be to delay thc time of melting an hour or more, to damage the goodness of the metal itself beyond recovery, and to waste hundreds weight of coal. We should always, therefore, in practice, have a furnace-man to each furnace, or at the most to two twin furnaces alongside each other; and confine the assistauce he receives from four labourers merely to the carrying up of metal and fuel &c. In an operation where skill and attention count for so much, there should be no room in the event of evil results, for laying the blame on "somebody else." Such is the delicacy of working—so multiplied are the sources of difference in the working of air-furnaces—that even with the best designed furnaces and the most experienced and careful furnace-man—more or less—we may indeed say great, variability of result will be found to arise occasionally. Not often, when *everything* remains the same and the routine, in all respects, is unaltered for weeks or months; but a new brand of pig iron, new lumps of heavy or light broken scrap metal, variations of qualities of coal, are at first pretty sure to give more or less trouble. Nor are apparently minor causes without producing now and then a very sensible effect, where all else is unchanged. The state of the atmosphere, as to damp or dryness or temperature, and most of all as to great variation of barometric pressure, or during times of baffling winds or storms, produce inconveniences,

Fig. 5.

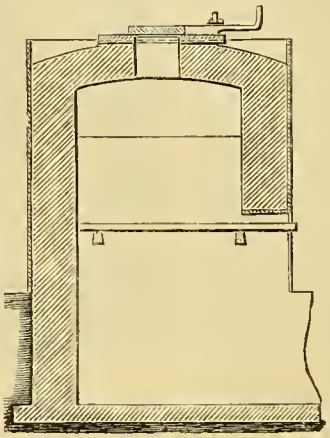
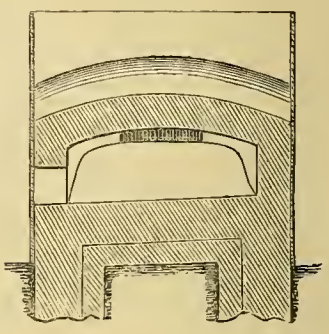


Fig. 6.

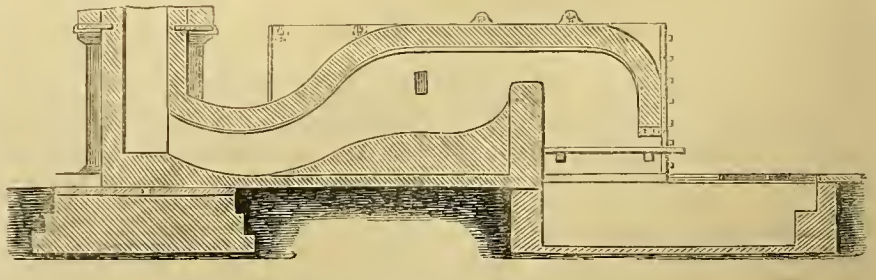


delays, and trouble sometimes, that furnace-men seldom trace to their real sources. Nor is this at all surprising when we consider the tons of air that are drawn through a reverberatory, and the delicate balance of the urging and retarding forces of the draught by which it is impelled.

We have thus pretty fully exhausted the subject of air-furnaces for iron-foundry use, and perhaps treated them more fully than would seem warranted to those who view such instruments of fusion as belonging to an epoch gone by. They are so probably, as respects the fusion of cast-iron, but they must always, or at least while ever solid fuel is that burnt, continue to be the great resource of the bronze copper and brass casters upon the great scale; for that reason, and as so much that we have written applies to the melting of these metals, equally with iron, we have not treated our subject at needless length.

In addition to these examples of air-furnaces, we are enabled to produce auother of more than usual value, *viz.*, one of the latest constructed furnaces employed at Low Moor Ironworks, for the casting of guns and other things from the superb material produced there. This furnace is capable of being modified in similar dimen-

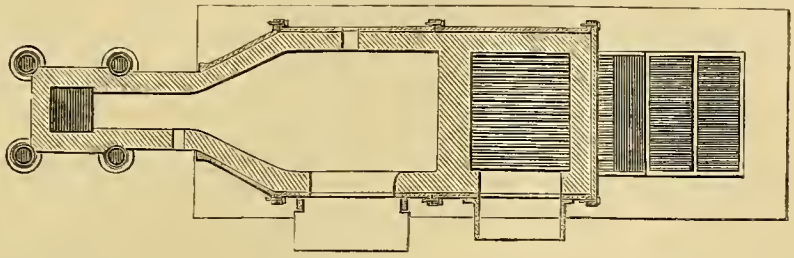
Fig. 7.



sions, so as to melt from 5 to 10 or 12 tons of metal, and is of very simple and firm construction. The chimney is carried up independently, to about 50 feet in height, jacketed in plate-iron

for the entire height, and provided with a damper-valve on top. The fire-grate is 5 ft. ×4 ft. 6 in.=22½ sq. ft. total area, wrought-iron bars 1¾ inch square. The height of the throat between crest of bridge and the arch above, 12 inches. The length of the flame-bed and pool is 11 feet 9 inches, and might be filled to a mean depth of 24 inches with fluid metal, the width being 5 feet, which is also the

Fig. 8.



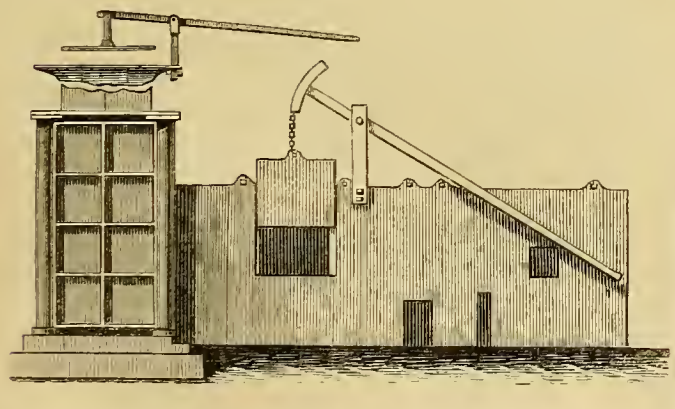
width over the bridge. The *possible* content is above 100 cubic feet, or about 19 tons total capacity; up to this limit, however, the furnace at the dimensions shown could not with any certainty be worked; it may be viewed as a 10-ton furnace. The writer is indebted to Messrs. Hurd, Dixon and Hardy of Low Moor for the drawings of this furnace.

Fig. 9 is a side elevation; fig. 10 a vertical longitudinal section, and fig. 11 a horizontal section of the furnace, showing a portion of the chimney stack. (In fig. 11 the fire bars are shown wider apart than they would be if closed up in action.)

One word more before finally leaving this part of our subject. What, let us ask, would appear, to those who look from our existing tools and methods to those of a little distant coming time, to be *the future* of iron-melting?

We hesitate not to say—*the gas blow-pipe*. No one who has ever worked with a "Bunsen burner" and a platina crucible no bigger than a thimble upon a laboratory table, and come to know the melting powers of coal gas, or that evolvable from slowly burnt coal mixed with common air, and security taken that the heat given into the crucible be not in great part and as fast lost by radiation, can doubt that gas cupolas, worked with rapidly flowing mixed streams of hot carbonic oxide, and other gases from coal, possibly with the heated vapours of petroleum, or coal oils, duly mixed with hot air, and, perhaps, with oxygen in part, when that com-

Fig. 9.



modity shall have got attainably cheap, will be the instruments of fusion for the iron-founder before the end of this century—probably much before it.

In connection with and in concluding this chapter on the melting of iron, we may notice a somewhat curious modification of cupola melting, employed within the last two years in certain foundries about Newcastle-on-Tyne, and stated to be attended with a notable economy. This method is based upon the practicability of recovering some of the iron contained in the silicates and oxides of iron of puddling furnace slag or "cinders" by melting those, along with cast-iron, in the cupola. When the ordinary cupola has been blown to a high temperature beforehand, it is charged with a ton of pig-iron, a ton of "cinder," 4 cwt. of argillaceous clay, and 4½ cwt. of limestone, along with half a ton of coke, the charging being done, of course, in successive moderate batches, as usual. After fusion, if the "cinder" has its usual richness—say, 55 to 58 per cent. iron—there is tapped out a ton and a quarter, or even a nearer approach to 1 ton and a half of cast-iron. The cast-iron obtained is hard and white, or mottled, even though the pig-iron charged in, be gray iron. The product might often find employment in the foundry for large and coarse, or very strong castings. In the north of England, however, it seems to be laid aside, and consigned to puddling again, a course which appears disadvantageous in view of the concentration of the phosphorus in the result.

Fig. 10.

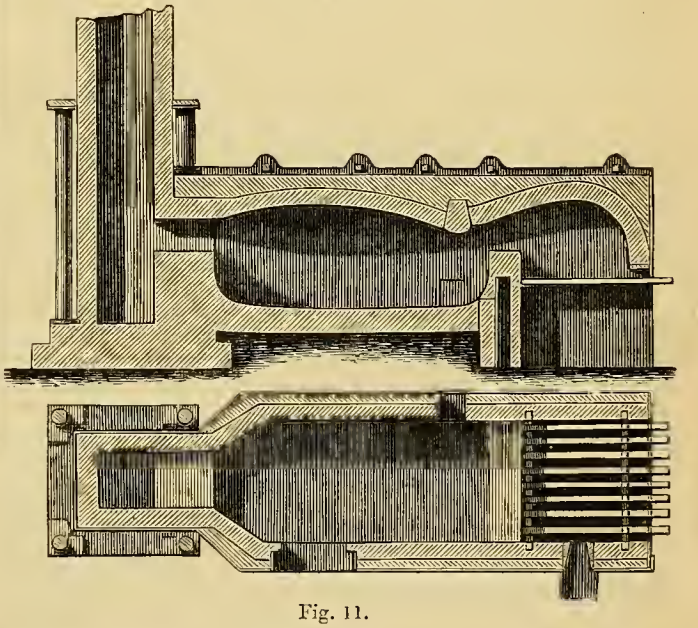


Fig. 11.

So far as other chemical principles are involved, this process is correctly founded, and, indeed, presents close analogy with the facts of the puddling furnace itself, in the reduction of the oxide of the slag by the metal charged in. How far the method may prove economical, or the contrary, we have obtained no exact information; but we entertain great doubts on this point. There are two obvious disadvantages—the necessity for consuming fuel to fuse 8 cwt. at least of otherwise useless earthy matters, which act as reagents, and the deterioration of the quality of the pig-iron charged in, by loss of silicon and carbon.—Ed.

## SOME CONSIDERATIONS AS TO BESSEMER'S AND HEATON'S STEEL PROCESSES.

A Communication by Charles Schintz, Engineer, Berlin. Author of *Dokumente betreffend den Hohofen zur Darstellung von Roheisen, etc.*

A friend of mine had sent me from London a pamphlet on Heaton's *Process for the Treatment of Cast-iron and the Manufacture of Steel*, London, Stanford, 1869, which contains a full report of the dispute

about Bessemer's and Heaton's respective steel-making processes, in which not only the leading technical journals of England, but even the political press, such as the *Times*, took part in favour either of Bessemer or Heaton, though with but little real knowledge. This dispute is now in fact very much one, as the German people say, "about the emperor's beard," for Bessemer's and Heaton's processes are not only of wholly different natures, but must pursue even different ultimate aims. Both processes coincide only in so far that in both the reagents necessary for the refining of the crude pig-iron are brought into contact with the latter in a more effective manner than previously. Bessemer preceded in that respect, and Heaton's process is, to a certain extent, only an ingenious following out of Bessemer, but with quite a different reagent. Bessemer's reagent is atmospheric air, which was used as such ever since wrought-iron was produced. Heaton's reagent is nitrate of soda, the sister salt to which (nitrate of potash) was already used in 1830 or thereabouts by Dr. Engelhard as a means for the refining of the crude pig-iron.

Now, when Bessemer asserts that his reagent *does not cost anything*, he commits either a grave mistake, or intends simply to throw sand in the eyes of the public; for, accurately considered, it is not the oxygen of the air, but the pro-oxide and per-oxide of iron, which are produced and taken away from wrought or crude pig-iron, which act as reagents, and so the real measure of cost of his reagent is, how much iron in the ton of his raw material does he destroy in order to refine the remainder? Bessemer's process is only applicable to those crude pig-irons which contain little carbon of superior purity, and which are very dear; but practice proves that his process wastes one-fourth of this pig-iron, and his reagents, therefore, not only cost *something*, but even more than in the ordinary puddling process where air is the reagent likewise. If we take further into consideration that Bessemer's process requires pig-iron that costs about 25 per cent. more than pig-iron of less or of even the same purity, but containing more carbon, we shall find that the saving with Bessemer's reagent is very insignificant in comparison with the use at present of nitrate of soda as a reagent; and this difference might under other circumstances wholly disappear. Bessemer's process, however, possesses the important advantage of producing an easily running product, a metal which can be cast at once into ingots, whilst the product of the Heaton process must be again more or less further heated up to fusion in order to be transformed into ingots or into steel. This disadvantage of Heaton's process, however, is again compensated by its admitting of the use, not only of crude pig-iron containing much carbon, but even crude pig-iron obtained from the very worst ores, which, of course, is by very much the cheapest. Whether, again, this saving by the considerably cheaper raw material which Heaton can use, is possibly not again lost by the inferior value of his final product, cannot yet be pronounced as decided, for Heaton's process has not yet reached that perfection which it certainly is able to attain, and must yet attain, if duly studied experimentally. That may be quite correct which the Commissioners of the United States for the Paris Exhibition of 1862 said about the Bessemer steel process: "It is a remarkable exception in the history of inventions, inasmuch as it has rewarded the inventor and the general public, but not the manufacturers."

The circumstance that the Bessemer process has not been advantageous to the manufacturer is easily explained by the fact that it passed at once into practice in a very imperfect state, without the inventor knowing or stating at first the conditions which secure his best success. Even an exact and fixed criterion for determining the moment at which the whole of the carbon is eliminated from the pig-iron, and which requires for economy the immediate suspension of the action of the air, seems to have been found only very lately, just at the time when Bessemer's patent is about to expire. It seems, according to the specification of Bessemer's first patent (which, however, I have not before me), that his earliest idea was to consume only so much of the carbon in the pig-iron by means of the air, that a sufficient quantity should remain to form steel. This idea appears to have been realised in Sweden; but, if so, it seems to be impossible with the best sorts of crude pig-iron as produced in England, France, and Belgium with mineral fuel. It was only subsequently found that the production of steel is better attained if at first all the carbon be eliminated, and then again the right proportion be added in the form of spiegeleisen. But the difficulty in this method, as well as in that used in Sweden, consists in finding the right point to stop at in order not to burn away uselessly too much iron; from this it results that the greatest uncertainty arises as to how much spiegeleisen ought to be added to restore the required quantity of carbon, for one part of that material is used up for the reduction of the iron, if any, burnt in excess. It is still more difficult to find this right point in the original Swedish method. Of course, the manufacturer could not obtain, under such circumstances, any uniform product, and many unsuccessful operations nullified the profit of the successful ones. In fact, want of uniformity has been the bane of this process. The long-required criterion seems to have been found at Seraing, in the application of the spectroscope, which indicates immediately the moment of total elimination of the carbon. This method, however, is not applicable to the Swedish method, and its practice in England is not said to be either universal or satisfactory.

Heaton's process has still to be improved by an extensive and persevering course of experiments upon the large scale, coupled with the suggestions of competent observers, and it would be, therefore, unfair to compare yet, or at the present moment, and in a positive manner, its economical advantages with those of the Bessemer process, improved as that now is by years of practice and lavish losses on the part of manufacturers engaged in its use; and this the more so, as the aim of Heaton's process cannot be to supersede entirely the Bessemer process, but to admit of the profitable employment of common brands of pig-iron for the production of steel; perhaps of inferior quality, though this even is not yet proved, but which, nevertheless, might be used with great advantage for many purposes. When I heard first, some time ago, of Heaton's process, I thought that it must offer this advantage over the Bessemer process, that the quantity of the reagent might be regulated exactly in proportion to the matters which have to be eliminated from the crude pig-iron. But the experiment, obvious as it is, seems not even to have been tried by Mr. Heaton, to proceed according to previous calculations based on analysis. The published experiments show that not only the nitric acid acts as an oxydating agent, but also the soda, which is partly reduced, and that the success of the result depends, not alone upon oxydation, but also upon the quantity of that base which the oxydated products combine with, and probably also upon the base of the soda alloyed temporarily with the refined iron.

The following are the results which Professors Miller and Grüner (see *Études sur l'Acier. Examen du procédé Heaton, par Grüner, Inspecteur général des Mines. Paris, Dunod,* 1869) have obtained from the analyses of the pig-irons and the products of the convertor:

Professor Miller. Pig-iron No. 4 from Clay Lane and Staunton, both produced from equal parts of oolite ores—

| Composition of the pig-iron | | Composition of the product of the convertor | |
|---|---|---|---|
| C | = 2·830 | C | = 1·800 |
| Si | = 2.950 | Si | = 0·266 |
| P | = 1·455 | P | = 0·298 |
| S | = 0·133 | S | = 0·018 |
| As | = 0·041 | As | = 0·039 |
| Mn | = 0·318 | Mn | = 0·090 |
| Ca | | Ca | = 0·319 |
| Na | | Na | = 0·144 |

Grüner. Pig-iron from Longwy produced—

| | | | |
|---|---|---|---|
| C | = ? | C | = 1·200 |
| Si | = 1·050 | Si | = 0·160 |
| P | = 1·650 | P | = 0·640 |
| S | = 0·350 | S | = 0·190 |

Gray Pig-iron from Hayange produced—

| | | | |
|---|---|---|---|
| C | = ? | C | = 1·210 |
| Si | = 3·024 | Si | = 0·530 |
| P | = 1 275 | P | = 0·920 |
| S | = 0·090 | S | = 0·010 |

There remain thus in the products of the convertor :—

| Clay Lane and Staunton | Longwy | Hayange |
|---|---|---|
| Si 9 per cent. | Si 15 per cent. | Si 17 per cent. of the original contents |
| Pas 20 | Pas 39 per cent. | Pas 72 „ |
| S 13 | S 54 „ | S 11 „ |

which appears by no means satisfactory, especially in respect to P, even if the contents of this be still reduced by further manipulation after the convertor.

Examining the two latter results of the analyses more minutely, and supposing that both sorts of pig-iron contain 3 per cent. of carbon, half of which has to be eliminated, we find

The contents of the existing carbon which had to be eliminated, was in the pig-iron from Langwy.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 10·80 Kilo. | C, | which, in order to form | CO, | absorb | 14·40 Kilo. | O and produce | 25·20 Kilo. | CO |
| 6·48 „ | Si | „ | „ | $SiO^3$ | „ 7·40 | „ | 13·88 | $SiO^3$ |
| 10·22 „ | P | „ | „ | $PO^5$ | „ 13·19 | „ | 23·41 | $PO^5$ |
| 2·40 „ | S | „ | „ | $SO^3$ | „ 3·60 | „ | 6·00 | $SO^3$ |

Required quantity of O = 38·59 Kilogrammes.

and in the pig-iron from Hayange :—

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 10·59 Kilo. | C, | which, in order to form | CO, | absorb | 14·12 Kilo. | O and produce | 24·71 Kilo. | CO |
| 21·17 „ | Si | „ | „ | $SiO^3$ | „ 24·19 | „ | 45·36 | $SiO^3$ |
| 9·00 „ | P | „ | „ | $PO^5$ | „ 11·61 | „ | 20·61 | $PO^5$ |
| 0·71 „ | S | „ | „ | $SO^3$ | „ 1·06 | „ | 1·77 | $SO^3$ |

Required quantity of O = 50·98 Kilogrammes.

In order to effect this oxydation, 68 kilogrammes of raw nitrate were added for the pig-iron from Langwy, and 67 kilogrammes for that from Hayange. These quantities correspond with :—

61·80 Na O + $NO^5$ = 22·54 Na O and 39·62 $NO^5$
and 60·89 Na O + $NO^5$ = 22·22 Na O and 38·68 $NO^5$

The products of the action for $NO^5$ are partly NO, and partly $NO^2$ :—

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 39·68 Kilo. | $NO^5$ | can, | therefore, | produce | 23·17 | or 17·45 Kilo. | O, in the average | 20·36 Kilo. O |
| 38·68 | „ | | „ | | 22·92 | „ 17·19 | „ | 20·05 „ |

whilst 38·59 kilogr. and 50·98 kilogr. of O are required. It will thus be seen that the $NO^5$ has scarcely produced half the O that should have been necessary.

The quantities of NaO which had been taken for both sorts of pig-iron, have been 22·54 kilogr. and 22·22 kilogr. containing 5·82 kilogr. and 5.73 kilogr. of O.

Heaton however has added still further to the contents of silicic acid, and by adding to the nitrate of soda 9 kilogr. and 10·39 kilogr. respectively of sand, which contain 4·80 kilogr. and 5·54 kilogr. O, and we get thus in :—

| | | | |
|---|---|---|---|
| $SiO^3$ = 7·40 + 4·80 = | 12·20 O | −24·19 + 5·54 = | 29·73 O |
| $PO^5$ = | 13 19 O | | 11·61 |
| $SO^3$ = | 3·60 O | | 1·06 |
| | 28·99 O | | 42·40 O |
| in the Na O . . . | 5 82 O | | 5·73 O |
| whence the proportions | 1 : 5 | and | 1 : 7·4 O |

These silicates contain now so much acid, that there is no possibility that the existing quantities of base would absorb it, and the calculated quantities of $PO^5$ and $SO^3$. To add sand to the nitrate, is therefore altogether contrary to purpose and to principle in Heaton's process. Experience shows that if the base be FeO, it combines with no more of $PO^5$, so soon as the slags have absorbed 40 per cent. of Si $O^3$, and that corresponds with the proportion, 2 FeO + $SiO^3$ = 1 O : 2 4O = 1 : $1_{,}5$, whilst in Heaton's method $SiO^3$ gives 12·20 and 29·73 O for 5·82 and 5·73 basic oxygen, which corresponds with the proportions.

$$\frac{12{\cdot}20}{5{\cdot}82} = 1 : 2{\cdot}1 \quad \text{and} \quad \frac{29{\cdot}73}{5{\cdot}73} = 1 : 5{\cdot}2.$$

But the calculated contents have by no means been found as those really contained in the slags :—

| | | | | | |
|---|---|---|---|---|---|
| Longwy 31·00 | per cent. of | $SiO^3$ | Hayange 54 | per cent. | $SiO^3$ |
| 15·80 „ | | $PO^5$ | 1·60 „ | | $PO^5$ |
| 0·70 „ | | $SO^3$ | 0·50 „ | | $SO^3$ |
| 0·60 „ | | S | | | S |
| 30 40 „ | | Na O | 29 00 „ | | NaO |

with small quantities of Ch, Ca, Fe . Mn, and Va.

| | | | |
|---|---|---|---|
| These contain in | $SiO^3$ = | 16 53 O and | 28·79 |
| | $PO^5$ = | 8·90 „ | 0 90 |
| | $SO^3$ = | 0·42 | |
| | | 25·85 | 29 69 |
| NaO = | | 7·84 and | 7·84 |
| whence the proportions | | 1 : 3·33 „ | 1 : 4 |

In the latter case almost nothing but $SiO^3$ has passed into the slags, and the NaO is saturated exclusively by $SiO^3$, and it cannot combine with any more $PO^5$. The more basic properties of the NaO against the FO, show themselves in the circumstance that a unit of weight of the former base is saturated by 4O out of the $SiO^3$, whilst one unit of weight of the basic O out of the FO, saturates itself already with 1·5 unit of weight of the O.

In the slags obtained from the pig-iron from Longwy, the 16·53O out of $SiO^3$, saturate 4O out of NaO, and 3·84O out of NaO, absorb then 9·32O out of $PO^5$ and $SO^3$. A sufficient quantity of NaO is, however, also wanted for these slags, in order to absorb all phosphorus and sulphur contained in the pig-iron.

The weight of the slags is calculated from the materials employed by considering the $SiO^3$ as the unchangeable ingredient :—

Longwy:
9 Kilo. of sand + 6·48 − 1·04 = 5·49 Si = $SiO^3$ as obtained from the pig-iron 11·51 = 20·22 $SiO^3$

Hayange:
10·39 „ 21·17 − 3·71 = 17·46 Si = $SiO^3$ 37·41 = 47·80 $SiO^3$

We thus get :—

| Longwy | | Hayange | |
|---|---|---|---|
| 20·77 Kilo. | $SiO^3$ = 9·69 Si | 47·80 Kilo. | $SiO^3$ = 22·31 Si |
| 10·58 „ | $PO^5$ = 4·62 P | 1·41 „ | $PO^5$ 0·61 P |
| 0·47 „ | $SO^3$ = 0·19 } 0·59 S | 0·44 „ | S |
| 0.40 „ | S 0·40 } | | |
| 20·11 „ | NaO | 25·67 | NaO. |

Next, the weight of the matter remaining in the convertor :—

| | |
|---|---|
| 0 99 Kilo. Si | 3·71 Kilo. Si |
| 3·95 „ P | 6·44 „ P |
| 1·17 „ S | 0·07 „ S |

We now get :—

| | | | | | | |
|---|---|---|---|---|---|---|
| | | Longwy | | | | |
| in the slags Kilo. | 9·69 | Si | 4·62 | P and | 0·59 | S |
| | 0 99 | „ | 3·95 | „ | 1·17 | „ |
| Kilo. | 10·68 | Si | 8·57 | P | 1·76 | S |
| Sand 4·20 } in the pig-iron 6·48 } | 10·68 | | 10·22 | | 2·40 | |
| Deficit | | | 1·65 | P | 0·64 | S |
| | | Hayange | | | | |
| in the slags Kilo. | 22·31 | Si | 0·61 | P and | 0·44 | S |
| | 3·71 | „ | 6·44 | „ | 0·07 | „ |
| Kilo. | 26·02 | Si | 7·05 | P | 0 51 | S |
| Sand 4·85 } in the pig-iron 21·17 } | 26·02 | | 9 00 | | $0{\cdot}7_1$ | |
| Deficit | | | 1·95 | P | 0 20 | S |

which had to be eliminated in any way, for the quantity of the existing NaO was not sufficient to bind them.

Of course the unenergetic base of the slags produced also in operating with the latter crude pig-iron, a much less complete elimination of the heterogeneous matters, but this elimination of P and S shows, nevertheless, that the high temperature which takes place in the convertor, cannot be without great influence upon the result.

Heaton is, therefore, again wrong in giving only small dimensions to his convertor, for the temperature is thus naturally diminished, whereas it should be the highest possible ; and if a high temperature in the convertor be desirable, it follows next that the perforated cast-iron plates, which cover the nitrate of soda, should be as thin as possible, and that their cooling agency is always a disadvantage. Besides this, larger quantities of nitrate of soda will not only oxidate the matters which have to be eliminated more completely, and introduce for their absorption more Na O, but will also increase the temperature in the convertor. We have seen that the matters which had to be eliminated from the crude pig-iron of Longwy require for their complete oxydation 38·59 kilogr. of O ; the 68 kilogr. of raw nitrate have therefore to be increased to 129 kilogr., whilst 170 kilogr. have to be substituted for the 67 kilogr. for the crude pig-iron from Hayange. In the crude pig-iron from Longwy then are to be combined, with the exception of the sand added :

Kilo. 7·40 O out of $SiO^3$, which require $\frac{7{\cdot}40}{4}$ = 1 85 basic O

„ 16 79 O „ $PO^5$ „ $\frac{16{\cdot}79}{1{\cdot}5}$ = 11·19 „

13·04 „

which requires 150 kilogrammes of nitrate.

In the crude pig-iron from Hayange are to be combined: —

Kilo. 24·19 O out of $SiO^3$ which require $\frac{24\,19}{4} = 6{\cdot}05$ basis O.

„ 12·67 O „ $PO^5$ and $SO3$ „ $\frac{12{\cdot}67}{1{\cdot}5} = 8{\cdot}45$ „

14·50 „

and this requires 169 Kilogrammes of nitrate.

Economical considerations will scarcely admit however such an augmentation of the nitrate at its present high price, for the quantities which are already used make it somewhat doubtful whether this process may not be too expensive in relation to the quality of the product.

M. Grüner, therefore, advises to increase at first only the basic matters in addition to nitrate, and not the oxidating agent, and to diminish next the excessively large contents of Si in such crude pig-iron as that from Hayange, by means of a preliminary refining in the Finery furnace. We shall have to say more about the first suggestion, and with respect to the second, we may state that it would be certainly more economical, notwithstanding the extra 9 frs. per 1,000 kilogr. of pig-iron for the preliminary refining in the Finery furnace, to so operate in the smelting or at the production of the pig-iron itself that its contents of Si shall be less, because its proportion of P and S are then diminished also.

But that again is connected with another question; although the oxydating agents act at first upon the Si, then upon the P and S, and only at last upon the carbon, we cannot say that, for example, at first the whole of the Si is eliminated before the P, S, and C are attacked, but that the latter substances are only oxydated in smaller proportions, for otherwise the Bessemer process could not require exclusively nothing but the purest brands of pig-iron. If, therefore, the proportion between the existing C and the existing Si, P, and S is small, the carbon will disappear before Si, P, and S are wholly eliminated, and the result will be that Fe is then oxydated and yet that no more carbon exists for its reduction. The success of the Heaton process will, therefore, be the greater the more favourable the proportions between the C and the Si, P, and S in the applied raw material shall be, and the less these substances exist in absolute quantity; it thus follows that the expensive reagent $Na\,N^5$ is best saved if in the first instance the operation in the blast-furnace shall be such as to allow the pig-iron to absorb only the smallest quantity of these disadvantageous substances.

M. Grüner thinks that the Heaton process as it stands at present can be only carried out with economy either by the nitrate of soda becoming cheaper than it is at the present exceptional time, or by other successful combinations being made which shall diminish the consumption of this reagent.

But another question has to be discussed, whether the final product, as obtained up to the present time, be good enough for use in steel rails. This question cannot yet be viewed as having been fully solved, and, although it may be decided in favour of the Heaton process, the problem, nevertheless remains for solution, now to make this process not only more economical, but to modify it in such a manner that a better final result shall be obtained—that is to say, a more absolute elimination of the Si and P.

The investigations of the physical conditions of Heaton's steel compared with those of other steels, are (as yet) quite incomplete and insufficient, so far they seem to show Heaton's steel as inferior with respect to its elasticity, flexibility, and tensile resistance, whilst its compressibility surpasses that of other sorts of steel. It is possible that this property may make the Heaton steels specially preferable for rails, but further experience alone can decide these points in a positive manner.

The writer of the pamphlet, *Heaton's Process for the Treatment of Cast-iron and the Manufacture of Steel*, appears to attribute to Mr. Heaton the honour of having by his results confirmed the theory according to which nitrogen forms a necessary ingredient of steel. To me it appears that it has not even been attempted to confirm that theory by the products obtained with the Heaton process: none of the analyses made determining the contents of nitrogen in Heaton's steel. There exists, however, no doubt that that molecular state, which is a peculiarity of steel, is, at least to a certain degree, a property also of Heaton's products, and that this circumstance does not square with the assumption hitherto made, *viz.*, that this molecular state can only be obtained with ores which are easily reduced and with pig-iron produced at low temperatures.

Of all elements, oxygen is about the only one that is able to separate the Si, P, S, and C from the crude iron, and of the compounds with oxygen, nitric acid is the only one which, combined with bases, produces salts as easily fused and decomposed as are those required for Heaton's convertor, so that the mass at the increased temperature may remain in a fluid state, and thus bring the means for oxydation as well as the base of the oxydating agent into sufficient and prolonged contact with the mass of liquid iron to be operated upon.

But if the high temperature were conserved in a better manner by increasing the capacity of the convertor, or otherwise, and if the bases were chosen and combined in such a manner, that they should produce the most liquid slags, a good deal of the now expensive nitrate could, no doubt, be saved.

It has to be considered with respect to the bases, that their value for combining with the oxidated matters and with the elements Si, P, and S is, as already stated, very different. FeO is saturated when the proportion between the base and oxygen is $1:1{,}5$, whilst NaO requires the proportion $1:4$; now what are the relations of the other bases in this respect? That is still an open chapter in experimental chemistry, which ought to be filled in order to advance with this special question, as well as with siderurgy in general. Amongst the bases which can practically be applied is one that influences the refining of crude pig-iron, as well as its production in the blast-furnace in a most favourable manner, and worthy of all consideration; this base is oxide of manganese, which seems to possess, at least with respect to S and P, when in reaction at the fuzing temperature an affinity which is possibly even greater than that of the alkali, generally applied in analysis for taking up SO and $PO^5$. Oxide of lead may also be mentioned, which Dr. Richter suggested years ago for the Bessemer process; the suggestion seems, however, not to have been duly taken into consideration, though said to be ineffectual when tried.

It will thus be seen that many combinations are still open and possible, for the improvement of the Heaton process with a view to its science, as well as with respect to practice with economy, and that several of these methods offer great probabilities of arriving at vastly improved final results. The invention of Bessemer, and also that of Heaton, have the merit in common of having increased the power of the respective reagents in play, by making the most intimate contact possible between them and the liquid metal, and by changing into operations which save time and labour the older methods which consume both. Bessemer and Heaton have both acted according to the English proverb, "Time is money;" but the proverb, "Knowledge is power," ought to have been not less justified by them. Neither have acted very strictly upon the latter, but especially in the Heaton process does there appear so far to have been a great want on the part of those practically engaged with his invention of adopting in advance the strict leadings of science.

There remains then so much to be yet done by the really scientific metallurgist, in order to develop to the best and highest extent possible the capabilities of this process, that he will be an unwise man who now pronounces it a failure, nor sees that it may yet contain the elements of a great and brilliant future career.

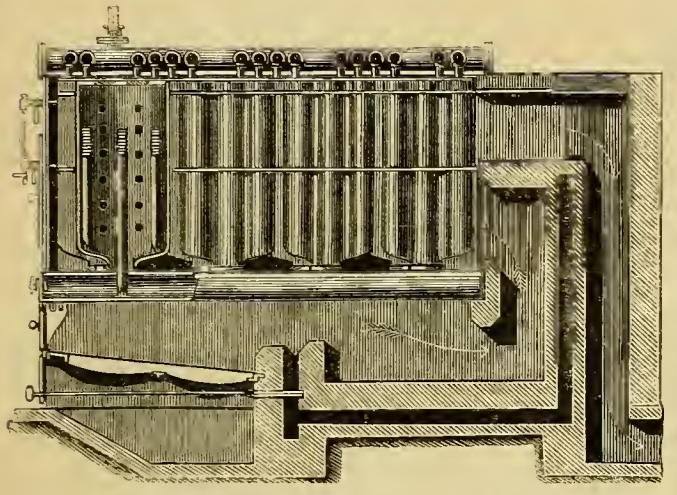
## THE SMITHFIELD CLUB SHOW, 1869.

The Smithfield Club show this year, in spite of "Foot and Mouth Disease," which has unfortunately shown itself in some of the live stock, and which, we have been informed by an eyewitness, made its presence known as early as the first day of opening even, is as flourishing as ever. The implement department, with which our readers are more particularly concerned, presented a most satisfactory appearance both as regards quantity and quality of the articles displayed.

Although absolute novelties were perhaps few and far between, still a steady improvement may be traced each succeeding year in

the design and workmanship displayed in many of the implements. Commencing our inspection at the first stand down-stairs, we noticed a Unit boiler exhibited by Kinsey, Morton, & Hill, of the Robin Hood Works, Nottingham, composed of a series of units or chambers with corrugated surfaces connected with horizontal water tubes, and closely packed side by side with the corrugations breaking joint so as to economise space. Our engraving, fig. 1, represents a vertical section of this boiler, which has many features to

Fig. 1.



recommend it. This firm exhibited also some well-arranged steam engines, including an excellent specimen of combined vertical engine and boiler of 6-horse power. Robey & Co. (Limited), Lincoln, had a good show of portable engines, and a neat 4-horse vertical engine on Field's boiler.

Wallis & Steevens, Basingstoke, exhibited an 8-horse power portable engine and a serviceable-looking combined thrashing machine with 54-inch beaters and chaff-bagging apparatus. A well-made 8-horse power self-moving agricultural engine was exhibited by Garrett & Sons; also, one of Hayes' improved straw elevators, along with some good specimens of corn drills. As usual, Richard Hornsby & Sons came out well in reapers, and exhibited a well-arranged 8-horse power portable engine with plenty of steam room in the boiler.

William Tasker & Sons, Andover, were represented by an 8-horse power portable engine, a combined thrashing machine, and some of their corn-dressing machines.

Tuxford & Sons contributed a 10-horse power housed steeple engine, and others of smaller power, all displaying good workmanship and design. The heaviest engines in the show were to be found at the stand of John Fowler & Co., who exhibited two ploughing engines of 14 and 12-horse power, and a harrow and cultivator for steam cultivation. Several beautifully-finished horizontal engines, as well as an 8 and a 10-horse power portable engine, were exhibited by Clayton & Shuttleworth, to whom we may safely award the palm for beauty of finish and design.

Burrell, of Thetford, was represented by a 12 and an 8-horse power single cylinder traction engine. The 12-horse engine is provided with double power for ploughing and road motion, winding drum and coiling gear on Fowler's system; and the 8-horse engine is also fitted with double power and double chains, and is mounted on springs.

We noticed one of Hawkes & Spencer's ingenious chain corn drills, which have been previously noticed in our pages, at the stand of W. S. Underhill, of Newport, Salop. James & Frederick Howard occupied a considerable space in their usual corner, with a good show of steam ploughing apparatus, reapers, and horse rakes. We particularly noticed a double furrow plough, with new swing frame, constructed on the simplest principles, and a self-acting horse rake with eccentric and break strap for clearing. The Beverley Iron and Waggon Co. (Limited), exhibited some good clod-crushers, mowers, and reapers, some of the latter being provided with reversible self-acting swathe delivery. E. R. & F. Turner had on view a 5-horse power portable engine and a large collection of their well-known crushers and seed mills. Aveling and Porter were well represented by a 12-horse power winding engine for steam ploughing, and an 8-horse power agricultural locomotive engine.

Two well-made 6 and 3-horse power portable engines were exhibited by William Allchin & Son, and an 8-horse power portable engine by Ransomes, Sims & Head, along with a large display of ploughs, for which this firm is justly celebrated. Chaff cutters and light implements were well represented by the collection to be found at the stand of Ashley & Jeffery, whilst Woods, Cocksedge, & Warner supplied a large collection of crushing and grinding machinery, and a useful looking, though not handsome, vertical 3-horse power steam engine and boiler.

Ruston, Proctor, & Co. exhibited a 12-horse power double cylinder portable steam engine, an 8-horse single cylinder portable engine, a 6-horse fixed engine, and a well-made self-acting circular saw bench.

A large display of steam power engines, both fixed and portable, was made by the Reading Iron Works (Limited), who also exhibited the well-known "Clipper" mower, and several horse gears. Two good specimens of vertical engines were exhibited by Marshall, Sons, & Co. (Limited), fitted with Hartnell & Guthrie's expansion eccentric. Brown & May exhibited an 8-horse power portable engine.

Some good specimens of farm carts and waggons were shown by William Crosskill & Sons. Double and single flour mills were well represented at the stand of John Tye, of Lincoln, who has long made this particular class of machinery his speciality.

Our space compels us to pass over many of the very numerous exhibitors in the galleries. We noticed here an exceedingly simple and effective little lawn mower, exhibited by Williams & Co., with Archimedean cutters.

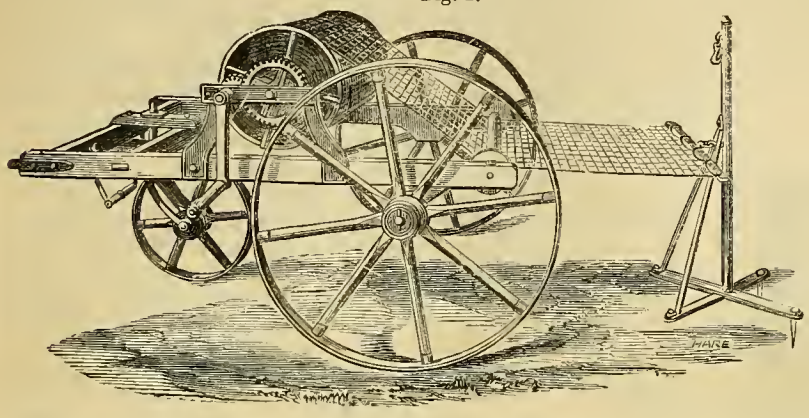
Arnold & Sons made a good display of veterinary surgical instruments and miscellaneous articles of a useful nature. We particularly noticed one of Mr. Fleming's graduated drawing knives for preparing the periplanter; it is fitted with an adjustable slide for shoes of different width. We also noticed several of Adie's horse clippers, and a set of hunting sandals to be used temporarily in case of casting a shoe. These sandals are composed of leather uppers with a jointed shoe secured to the sole and provided with laces for attachment to the hoof. A useful standard for measuring the height of animals was also exhibited here, enclosed in an ordinary walking cane. John Armstrong, of Penrith, exhibited a useful set of jointed harrows, taking a breadth of nine and a-half feet at one traverse.

A 1-horse power Hugon gas engine was exhibited at work by F. B. Vallance, of Bridge Street, Greenwich; and a gas generator, the invention of Mr. Krom Schroeder, is exhibited in operation by the agents, Messrs. L. Birnstingl & Co., of Basinghall Street. It embodies the well-known system of rendering atmospheric air inflammable by bringing it in contact with liquid hydrocarbons by means of bellows worked by clockwork; the inflammable air being then burned in ordinary gas-burners. Samuel Owens & Co. exhibited a large assortment of pumps and other hydraulic appliances, and strongly advocate the claims of Bernays' centrifugal pumps. We noticed quite a crop of diamond millstone dressing machines this year, a new importation to the show, due probably to the success which has attended the working of Golay's machine. Amongst the exhibitors of this class of machinery are James Lee Norton, Bryan Corcoran & Co., and William R. Dell. The machine exhibited by Norton differs from all other diamond millstone dressing machines we have seen, in the action of the diamond, which, in lieu of revolving at a high velocity, simply acts as a planing tool, being slid to and fro by hand over the stone between suitable guides in a heavy adjustable levelling frame resting upon the surface of the stone. This machine is known as Mortlock's Patent Millstone Dressing and Levelling Machine. Its construction is certainly the simplest of any. The other machines are on the rotatory system.

Richard Winder, of Farningham, Kent, exhibited a novel contrivance for folding sheep, where string or wire netting is employed, the net being unwound and wound off and on to a roller carried on a frame mounted on wheels, instead of being carried in the shepherd's arms, as in the old system. Our illustration (fig. 2)

shows the machine for folding sheep where netting is used. The netting is always evenly wound upon the rollers when not in use, instead of being left in heaps upon the ground, to rot from wet, as was formerly the case. Each roller is made to hold one hundred yards of netting, as most convenient for one man to carry about

Fig. 2.



wherever it is required, the weight being one hundred weight. The shifting of the rollers is very simple, easy, and quick. In laying out the net, the wrought-iron end standard shown in the engraving is fixed. The centre ring on the lath at the end of the netting is fixed to the centre hook of the standard, the man draws the machine forward by the end handle, which lays out the netting evenly along the ground. The ordinary stakes are fixed in the ground at about 12 feet apart; each stake has two 4-inch clout nails driven in them at about 3 feet apart, the lower one being about 1 foot from the point of the stake. One turn is given on each nail, and the fold is fixed; between the 12 feet distance the bottom of the net is pegged to the ground to keep the sheep from getting under. To shift the fold, all that is necessary is to untwist the net off the nails, pull up the stakes, and wind the netting on the roller; while winding, the machine travels towards the fixed end standard, and it travels very easy and light, as the machine weighs only 1½ cwt.

The following are a few of the advantages claimed by the inventor:—

The fold is quickly made by it, and as quickly taken up.

It is light and portable.

The netting is always evenly rolled upon the barrel when not in use; consequently, all wet drains off, and the net is preserved.

Its use in muddy and wet weather is clean and dry for the shepherd.

improved anchor (shown at fig. 3) a strong revolving shaft or lever is carried transversely upon the frame at the part where the end crossbar is usually fixed. On this bar there are eight or twelve tines clasped, according as the soil may be soft or hard, and the length for grappling is also regulated according to the hardness or softness of the soil. There are two or three tines clasped to each side of this iron bar. The object of these several sets of two or three tines is that the anchor may advance when required, by setting free the tumbling apparatus, and a fresh set of tines act as grapnels when the anchor has moved as far as the work done, or to be done, requires. This performance is accomplished by the simplest possible means. On one end of the bar which carries the tines is a ratchet with four catches, into which falls a notched lever. When this lever is left to itself, or is in position, the grapnel tines are held in a rigid position, and they then hold fast to the soil. And when it is necessary for the anchor to advance, the lever is raised from one catch, which allows the tumbler to revolve, and the next set of tines to work down or forward, and so come in contact with the soil as to enter it, and again bring the anchor to a dead stop.

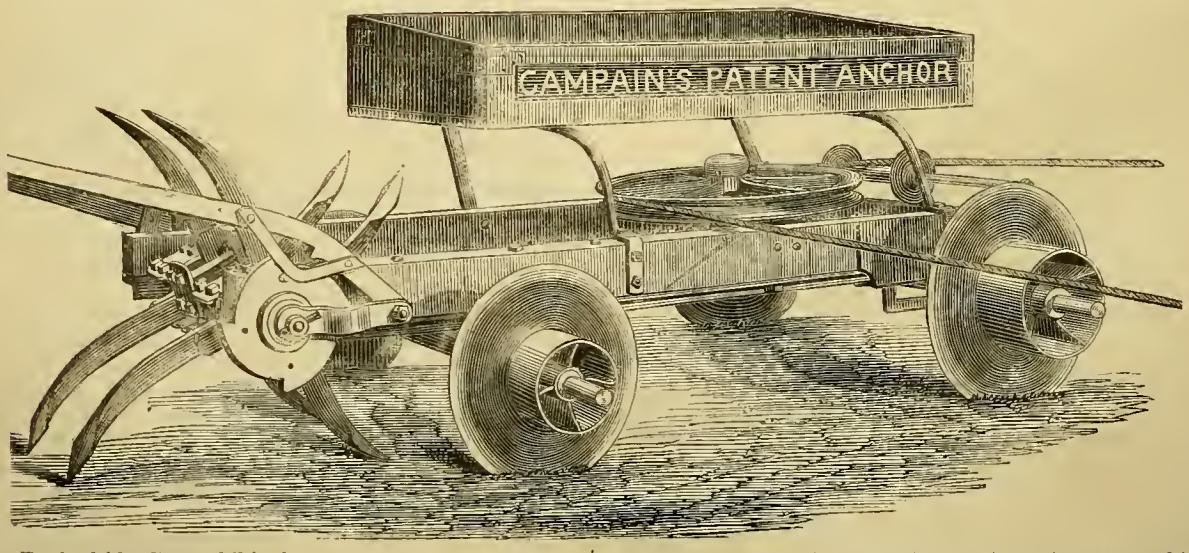
Burgess & Key made a good display of one or two horse reapers, with sheaf and swathe delivery, but without any marked novelties. An excellent collection of leather driving straps was exhibited by the Tanned Leather Company. William Nicholson, of Newark, exhibited some improved hay makers and a horse rake with end adjustment, consisting of a notched segment and spring lever for adjusting the teeth; also a cheap form of 3-horse power horizontal engine.

Samuelson & Co. had some good reapers and mowers. We noticed at the stand of S. & E. Ransome & Co. a useful little machine, new to the Smithfield Club Show, for sharpening the knives of reaping and mowing machines, the invention of Mr. Hemington, of Chatteris, which has already been illustrated in our pages.

E. H. Bentall is represented by a considerable display of chaff-cutters, root pulpers, and seed crushers. Edmund Gray, of Moscow Works, Sheffield, exhibited his patent steel and steel-faced grooved horse shoes, as well as his improved plough coulters, composed of steel and iron, which we have also noticed in a previous number.

James Cornes & Co. had, as usual, a large collection of serviceable chaff-cutters. The chief novelty in the show was Tangye's improved

Fig. 3.

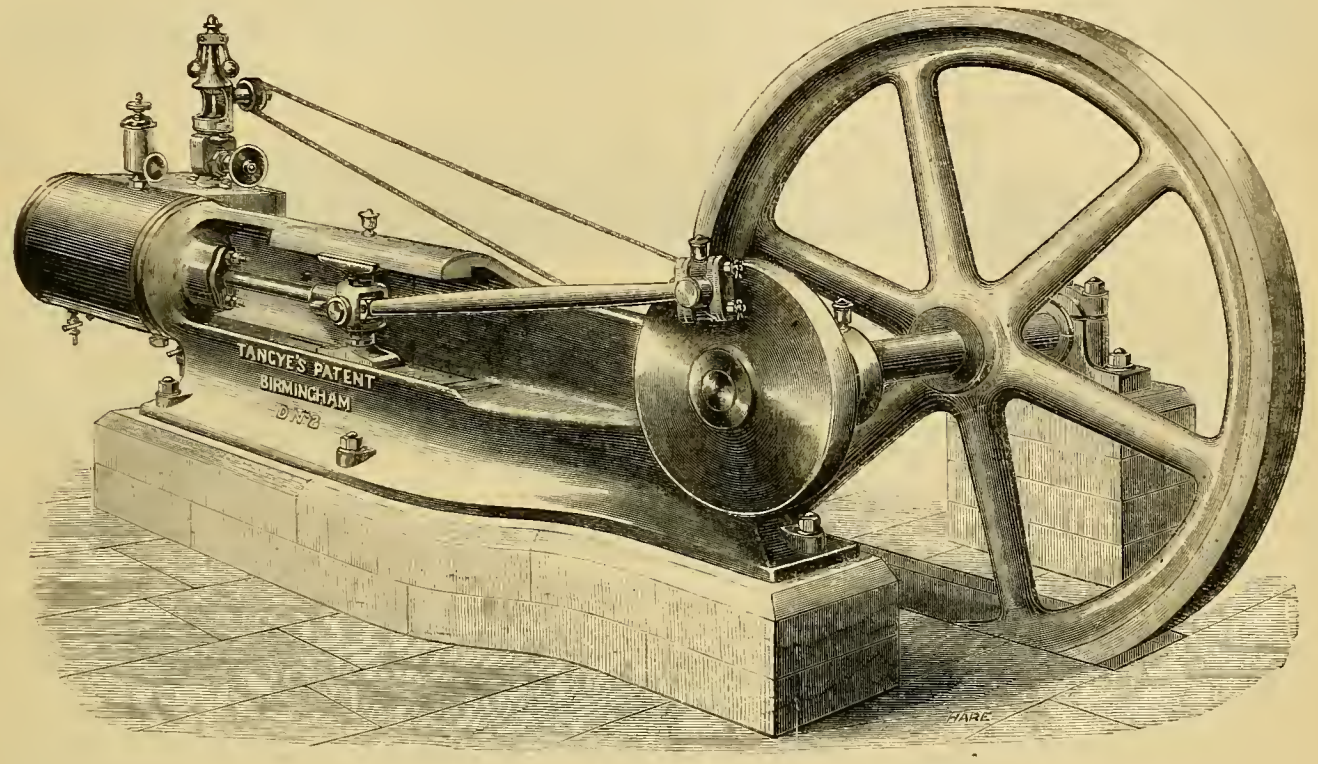



horizontal engine (fig. 4), fitted with his patent high-speed governors. This engine is a model of simplicity and compactness.

Amies, Barford & Co. exhibited amongst their collection a model of Campain's self-acting and self-moving anchor. In this

The bedplate, inner cylinder cover, guides, and main journal, are all cast in one piece, thus affording a degree of strength and rigidity never hitherto attained in this class of engines. Another important feature in these engines is, that all the parts are made to Whitworth's gauges, so that duplicate parts can at any time be obtained with perfect certainty of fitting.

Fig. 4.




Follows & Bate, Manchester, exhibited several very simple and useful lawn mowers, yclept the "Climax," one of the smallest size of which, a 14-inch mower, we illustrate at fig. 5. The delivery in these mowers is at the back, which allows the knives to cut close up to walls and trees, and underneath shrubs and flowers.

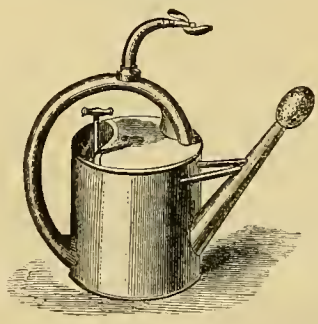
Fig. 5.

Brick and tile machinery was well represented by the excellent display of Henry Clayton, Son, & Howlett.

A glance at the miscellaneous collection in the avenue, and in what we may call the annexe, consisting of the new concert hall, converted into a veritable bazaar, must close our record of the Smithfield Club Show for 1869.

W. S. Boulton, of Norwich, exhibited some novelties, amongst which we may mention an improved machine for spreading liquid manure water; a new patent lawn-mower, previously noticed by us; and a new registered combined water-pot garden engine, in which the handle serves as an air vessel (see fig. 6).

Fig. 6.



In the avenue we found a capital display of light carriages, chiefly consisting of dog-carts and the like, amongst the greatest novelties in which we may mention Mr. Smith's "Perithron," with movable front seat to admit of a lady taking her seat by the driver from the back of the vehicle, instead of having to step over the wheel. This is a very neat contrivance; but in our estimation, more ingenuity is displayed in the neighbouring vehicle, exhibited by Newnham & Son, of Bath, and styled the "Metamorphosis." This vehicle forms three elegant carriages without any loose parts—viz., a driving phaeton, as easy of entrance as any park phaeton; a waggonette to carry six persons; and a family phaeton, whilst ample accommodation is afforded for luggage or dogs. This is accomplished by having the front seat supported on four parallel motion levers, which allow it to be moved forward or backward with the greatest ease, whilst the side seats are capable of being turned up out of the way when not required for use.

This firm exhibited also a very neat arrangement of "ladies' carriage step," to facilitate the entrance over the wheel; the "step" consists of three grades, all folding into one and sliding underneath the footboard when out of use; when required for use, the top step is slid out over the top of the wheel, and the remaining ones unfolded in front, presenting an easy means of entrance and exit.

In the heterogeneous collection of toys, Abyssinian and aluminium gold jewellery, umbrellas, waterproof paints, coffee pots, damp-proof bricks, rotatory pumps, and Polytechnic cement for mending crockery and glass, to be met with in the bazaar, we noticed several exhibits worthy of attention. Amongst these we may mention the impenetrable solution of R. Gay & Co., for rendering bricks damp-proof, several specimens of bricks treated with the solution being exhibited, upon which water seemed to have no effect whatever. The metallic flexible tube joints of Charles Marsden are both simple and effective; fig. 7 represents a half-socket forming part of this joint; fig. 8 is the under half-socket; B the flange with a furrow to receive packing; C the ball or protuberance with furrow to receive the packing of any material; the position it is placed in will cause it to last as long as the pipe, unless the pipe is removed for any purpose, when fresh packing will be required; fig. 9, joint completed by the addition of outer rings, and secured with wedges or screws; fig. 10, the hinge joint for steam and fire engines; this joint can be very quickly made; the simple flexible jointed pipe will follow over or under any inequality of ground or undulation, yet is perfectly air-tight; a joint is put in its proper place in a few

Fig. 7. Fig. 8. Fig. 9.

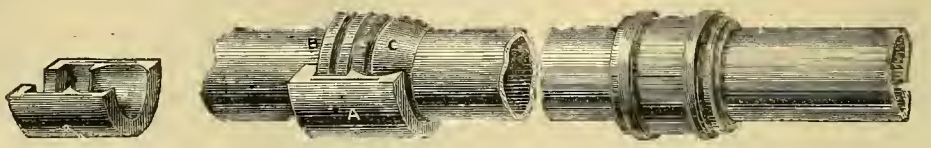
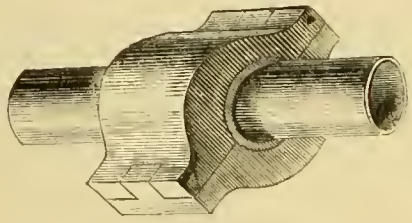


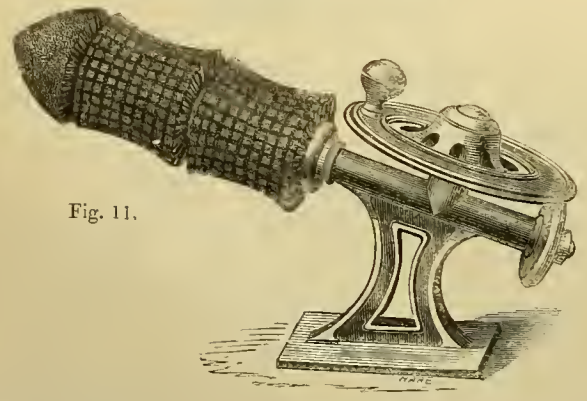

Fig. 10.



minutes, a defective pipe can be removed easily, there is no strain on the joint, as there is with rigid joints; when a pipe is to be removed, all that is required to replace another is to knock out the wedges and the two rings will slide off; or press the bolt in the hinge joint, lift the top half-socket, then the pipe can be removed without any breaking of flange either of iron or stoneware; no lead or cement is required, thus great saving of time is gained.

Ash's Kaffeekanne is an economical little contrivance for making

Fig. 11.



coffee in a hot-water jacketed vessel. An universal boot cleaner, by Charles Topham (see fig. 11), which is one of the simplest we have seen, consisting of a single cylindrical rotatory brush, the different sections of which remove the dirt, apply the blacking, and produce the polish. Finally, we may mention Smyth's improved umbrella, the construction of which is greatly improved, affording both increased strength and durability.

In concluding our notice, we must put in a protest against the practice of inserting in the catalogue numerous articles not actually exhibited, a practice which tends to confuse and mislead. In some cases, we found that out of a long list of articles, with their respective prices given in the catalogue, only a small minority were exhibited, swelling the catalogue, which ought to be strictly confined to the articles on view, into the proportions of a manufacturer's price list. We have been told that the reason for this is the necessarily limited space afforded to each exhibitor; but we fail to see the logic of this. If the hall will not contain all which the exhibitors desire to bring, why insert the excluded articles in the catalogue?

## MR. MACFIE, M.P., AND PATENTS FOR INVENTIONS.

(*Continued from page* 172.)

We ask, what is invention? The readiest answer is, "origination" in the mind of something which has not existed before, and in this, its strictest sense, is not a new book, a new picture, a new artistic design, or what else, an invention—equally with a new machine, a new process of manufacture? Why then is the securest possible possession to be awarded to one and sternly refused to the latter? In both cases the originators work to meet or to create a public demand or taste for that which they produce, and in both cases it equally rests with the public to decide the return they make to the originator, in both cases the public awards the result of the compact between the two parties.

The opening part of Mr. Macfie's speech in the House of Commons is noteworthy as taken from his own printed materials; he said, "It is indeed significant that they (manufacturers) do dislike patents, while they appreciate and honour inventors, even those inventors who claim from the State exclusive privileges, some of whom have the glory of being among the greatest benefactors of mankind."

If "manufacturers," as one branch of the public who create the demand, "dislike patents," and find no advantage to accrue from them, how is it that so many of them are patentees, and eager to invest their funds in a promising patent? Nay, how many of them owe their success entirely to a valuable patented invention! We need not tarry to hear what the Crossleys, Platts, Fairbairns, Tennants, Mr. Penn or the Maudslays, Mr. Young or Mr. Bessemer, and a host of other proprietors of the most important patents—to say nothing of the smaller or less important but valuable patents—would answer. We do not stop to ask how many of the members of the present House of Commons owe their seats there to the successful use of one or more patented inventions. Indeed it is pretty clear enough that Mr. Macfie himself has indirectly found a place there from the same cause, for let it not be forgotten that he himself patented in 1850 certain improvements in refining and preparing sugar, and manufacturing and treating animal charcoal; and even if he has not indeed enhanced his position by the working of his own patent, we may be quite sure that he has by those of his fellow-men, for the sugar manufacture has not been allowed to stand still, unimproved, more so than others. Does Mr. Macfie employ the vacuum pan of Howard? or does he use revivifying charcoal kilns or the centrifugal machine? We cannot doubt he would answer "necessarily so!" Then in such cases Mr. Macfie has been directly benefited by some most important patents.

To return again to our last extract—"They (manufacturers) appreciate and honour inventors." We ask, how? Does Mr. Macfie know

of Samuel Crompton or Richard Arkwright, of Henry Cort or Dud Dudley, of James Watt or Benjamin Huntzman, of Richard Roberts or the Peels, and dozens of other worthies? Did the manufacturers "appreciate and honour" these men? Alas, but too solemnly must we add, no! They pilfered and worried, oppressed, and often left them destitute, while in too many cases they employed others to obtain their inventions by stealth, in order to reap in selfishness their ill-gotten gains. Is the inventor in Great Britain of to-day to be left to their (the manufacturers') mercy, as the abolitionists would have them?—for it is too true in many cases that the aspect with which manufacturers now view inventors is not one whit in advance of the times of those sufferers above recited. This style of using inventors and patentees results directly from the inherent dislike which a manufacturer possesses at an outsider coming to him and telling him how to improve upon his adopted systems and modes of working. To some minds it amounts to the inventor or patentee saying that he knows your business better than you do yourself. This naturally enough fires that inner hid touch-cord which none of us like to be interfered with. Yet such is the keenness of competition on all hands nowadays, that a manufacturer cannot long afford to allow this feeling to shut out the inventor from his gates, and he knows that because the thing is patented he dare not attempt to work with it without the patentee's consent, lest he incur the risk of a law-suit. Accordingly one of the direct effects of the patent system is to establish fair dealing from the manufacturer towards the inventor. Yet if the personal rights vested in inventions were to be withdrawn, how would the inherent spirit of the manufacturer treat the inventor? Would he then be more likely to quietly listen to the inventor telling him how to better manage his own affairs? Would he appreciate and honour that man by giving him a reward suitable to the benefit obtained, as the present system compels him to do? We may safely answer in the negative. The inventor may now with greater propriety than ever exclaim to the State with regard to the abolitionist, "Save me from my friends, and I will take care of my enemies (the manufacturers)."

There is a fancy in the minds of some men, Sir William Armstrong for example, that inventors cannot help inventing; that they must do it as being the direct produce of a peculiarly constituted mental nature; that invention is a process over which they have no control, and that if they would stop it they cannot, any more than they can arrest the force of gravitation; and that consequently inventors need no stimulus to induce them to invent.

It is not to be denied that there are on the face of society a certain bold few individuals who continually believe themselves to be striking out new paths, methods, systems, but which never pass beyond the mere mental conception. Society at large is to some extent pestered with such erratic constitutions, by men whose mental arrangements are so muddled together and disorganised that they can only conceive, and imagine that they have, in so doing, achieved the greatest heights of human ingenuity, but who are utterly incapable of reducing ideas to practice. Still, be it remembered, these are not the men by whose suggestions either the State or themselves are benefited.

We are now brought to consider a weighty question, namely this—Does invention require stimulus? All genuine inventors without exception reply, "Yes, for without we would not labour after producing what is not, for the mere sake of producing it." No class of men are more imbued with the thought of advanced position (which a successful invention is sure to secure to them) than inventors are. But let us not be mistaken as advocating Mr. Macfie's view, who seems to think that a mere honorarium, a medal, or the possible chance of a paltry gift of money from the State, would be sufficient stimulus.

Such rewards are enough to incite emulation in schoolboys, but who would be so vain as to suppose that men striving in the current of the real business of life would or even could labour after such?

It is the stimulus which a properly administered patent law effects that urges on inventors, every one of whom knows that by means of such laws only can he get the closest approach to fair play compatible with the invidious tendency of human nature; and it may safely be predicted, that if anything should be done (but which we may be sure will not) to curtail the inventor's and patentee's privilege, by just so much shall we as a nation decline in our march of progress: whilst to those nations—America, France, Russia, and so on—who have the good sense of perceiving by our example how much the patent laws have done to advance our position upwards to the acme of civilisation, would our inventors flock to receive the protection there accorded them, and for this we could not censure them, even though they should look back upon the decline and coming desolation of the mother country.

In writing on this subject Mr. Dircks naïvely and most truly says, "The abolishing of the patent system would most assuredly bring about a revival of the infamous cheating in the sale of pretended *secrets*; and, consequently, *the charlatan's best friend is the advocate of the abolition of all patent right for inventions.* The great stimulus to invention is, unquestionably, pecuniary reward. No man ever yet published any really valuable invention for the sole honour of being the reputed inventor; for a good invention is legitimately considered to be the golden road to fortune."

The direct essence of all that Mr. Macfie has spoken—written or said—his replies, without exception, to the questions put to him by the Royal Commission in 1863, are clear proof of the importance and advantage of patents, for in the first place he shows that manufacturers do not suffer by patents, either on the ground of their being monopolies or through their multiplicity, or from the fact that patentees keep the patent solely in their own hands. For although Mr. Macfie states (1937)* that his firm were in one case refused a licence, let us see what *was* the result. He says, "We then altered our apparatus, at no small expense, causing us also some loss of time; and *though the patent has been for years expired*, we have not, even in other apparatus that we have since fitted up, to a considerable extent, adopted this patented principle." A clearer proof could not be given that either the mode of working ultimately adopted was superior to that covered by the obnoxious patent, or that the cost of introducing it would be greater than the advantage to be gained, or, what is the least likely of all, that being stopped in the use of the patent when they wanted it, Mr. Macfie's firm would not condescend to take it up when they could get it for nothing. This last view of the case, however possible, we do not deem probable, especially when, on Mr. Macfie's own showing, the competition in the sugar-refining trade is so keen, that he is content with a profit of 1 per cent. upon capital invested. Then, as to the great number of patents, he says (1939), "Anything that tends to multiply patents seems to me to multiply difficulties to manufacturers." Yet place this parallel with 1923, where he says, "I think it an advantage *that any idea whatever* might be registered, because out of a great deal of straw we might be able to get some grains of wheat." Let any impartial judge pronounce whether two statements could be more conflicting; indeed, is not the latter coincident with what actually happens under the existing *comparatively* cheap cost of patents, by which so large a portion of the nation are enabled to appropriate these ideas, and which would to an immensely greater extent take place if the cost of patents were lowered? An advantage of granting patents indiscriminately which may be urged, is the fairness, offered to all who think their inventions of value, that they are thereby enabled to test their importance or worthlessness; not that we for one moment advocate the indiscriminate granting of patents, which we deem highly objectionable, on the ground of interference with prior patentees which it often produces. Every application for a patent should be carefully examined by competent judges, and a greater length of time should be given to interested parties to file objections; whilst, at the outset, further information than what is afforded by the mere title should be supplied to the parties objecting, so that they would not be working in the dark, as is always the case with oppositions at present, when the title is the only public document.

Mr. Macfie's objections are, one and all, pure suppositions. He does not deal with facts, as he cannot; because such facts as he would like to have do not exist, for take 1944: "The only thing which I care for, speaking as representing a large class, is to get quit of *the annoyance which patents are calculated to give us as*

* This and the other numbers quoted in the sequel are the numbers of the questions put by the Royal Commission.

*manufacturers.*" Then again, in reply to a question (1945) put by Lord Overstone: "Do you find by actual experience that that annoyance is serious?"—"I cannot say that we have found it so." Take further (1947)—Lord Overstone: "Do I understand you correctly, that your experience in the sugar trade does not lead you to say that the multiplication of useless patents in existence creates inconvenience and embarrassment in the proseeution of your trade?"—"I wish to give the answer as bluntly as I can. Though they might be expected to be an annoyance to us, they are not; but any day they might become so. . . . We have not found the multiplicity of patents a great inconvenience." Again (1948), in reply to Mr. Grove, Q.C.: "In our business we have not felt it (the number of patents) to be a great hindrance." Also (1949): "As a general rule, I do not think that patentees hitherto have acted grievously."

Mr. Macfie's answer to 1959 is perhaps equally demonstrative of the hollowness of his objections. "There being 400 patents now in existence affecting your trade, none of which are made use of by you, do you find that the existence of these patent rights creates impediments and interruption and inconvenience in the prosecution of your business?"—"*Not in the smallest degree*, but if patentees were troublesome, as they might become under a change of the law and with a better organisation, we should find our business so uncomfortable that it would be almost necessary to retire from it. Every one of these parties *might* come and allege that we were infringing." Here the witness shows that not one of the 400 patents interferes with him, yet he objects to patents because they may at some future time do so. It is not usual in Parliament, or elsewhere, to adopt remedial measures before a grievance exists: if that does not exist after 17 years' experience, does Mr. Macfie suppose that the House will legislate to put a stop to what would most certainly have made itself palpably evident by this time, if it ever were to show itself at all?

It would be idle to pester our readers with many more samples of such a nature, for if we go from beginning to end of the evidence of this arch-enemy, his answers go to prove not only the importance and general good effect of patents, but rather that the multiplicity of patents is an advantage. According to this evidence, if it may be taken as worth anything, there was not a man in the land who in 1863 would have granted patents or permitted registrations to all and sundry to the extent which that gentleman would have issued them; indeed, acting upon his advice, the more patents we have, clearly the better, for to use his own words we might then be able out of so much straw to gather a few grains of wheat; yet to this not only ourselves, but every one who has paid somewhat closer attention to patents and their effects than Mr. Macfie has done, will demur, as it cannot be denied that numerous patents are granted which ought to be refused *instanter*.

To bring this examination quickly to an end, we will pass over several pages, coming to 2020. Lord Overstone, who evidently had distinctly seen through the hypothetical mind of the witness, asks: "Is not one of the strange things which happens in practice this, that in practice none of the apprehended grievances which you have expatiated on have occurred?" Answer: "But they must occur the first hour in which we have an important sugar-refining patent." (2022): "During the last ten years, the practical grievances which you apprehend as in prospect have not occurred?" Answer: "They have not occurred." It is not fair to ourselves nor to the cause of inventors, patentees, or the public, to consider the evidence of one man only. Let us take the other sugar-refiners, whose replies are printed at page 122 of the "Minutes of Evidence taken before the Royal Commission"—viz., Augustus W. Gachesellen. "Are you prepared to recommend the abolition of all patents?"—"To that question I am not prepared to give a decided answer." Messrs. Dunean, Bell, & Scott, of Greenock and London, reply: "We have never at any time been embarrassed in our operations through patents." James Smith, of Liverpool, answers: "In reply to your note, I do not think that the sugar-refining trade has ever been embarrassed by multiplicity of patents."

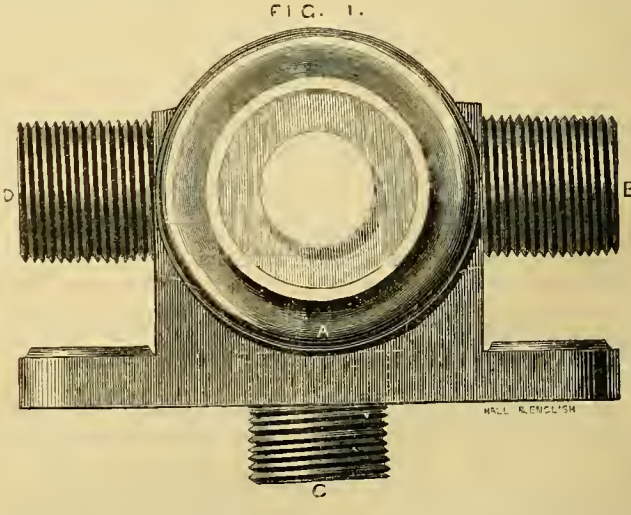
What is wanted is, that every patent, before it is granted, shall have passed through a certain test by which its validity shall be guaranteed; and if, to obtain this desired end, the present agitation shall tend, we may have some reason to thank Mr. Macfie for the cause he has taken in hand. Yet, whilst doing so, it is coupled with regret that the advocate is not more fitted for his cause; for Mr. Macfie's mental constitution seems quite incapable of considering facts, and dwells only on groundless fears for the future. If it were worth our while to follow him further, we could only do so by still exhibiting the hollowness of his views; and we do not think our readers will care to see our space further taken up by so doing. If, however, the course of events during the next few months should indicate the necessity of further examination, we may revert to it again. In the meantime, we would only add that if any of our readers care to pursue Mr. Macfie, they may do so by procuring his book from Messrs. Longmans, where it may be had for five shillings; and the preface of which tells the reader that he may do as he chooses with it, for "no rights are reserved." Yet we would caution any one taking it up, to be prepared for innumerable errors in quotations and facts; indeed, it is remarkable that in the opening chapter, entitled "Remarks on a recent Review," which purports to point out wherein the author has been misquoted in an excellent artiele which appeared in the July issue of the *Westminster Review*, and in endeavouring to reply to which, that in the chief extract which he makes, he has been guilty of either the carelessness or absurdity of putting it thus: "Speaking in behalf of the publie, we maintain that a patent law is necessary in any *uncivilised* community, because, without its protection, industry cannot flourish, and ingenuity can have no scope for its triumph." We will leave the solution of this passage to all whom it may concern. V. D.

## FENBY'S PATENT HYDRAULIC SLIDE VALVE.

Although Mr. Fenby's valve for water under great pressure requiring alternate supply and relief, as in hydraulic presses, has been now for some time before the public, it does not seem to have attracted the attention it deserves.

Other good valves are in use, such as those chiefly issued from Elswick works, but none seem to present the combined capabilities and simplicity of those in question. They appear to us capable of being enlarged, and might then be applied with advantage to water-pressure engines under heavy charges.

FIG. 1.



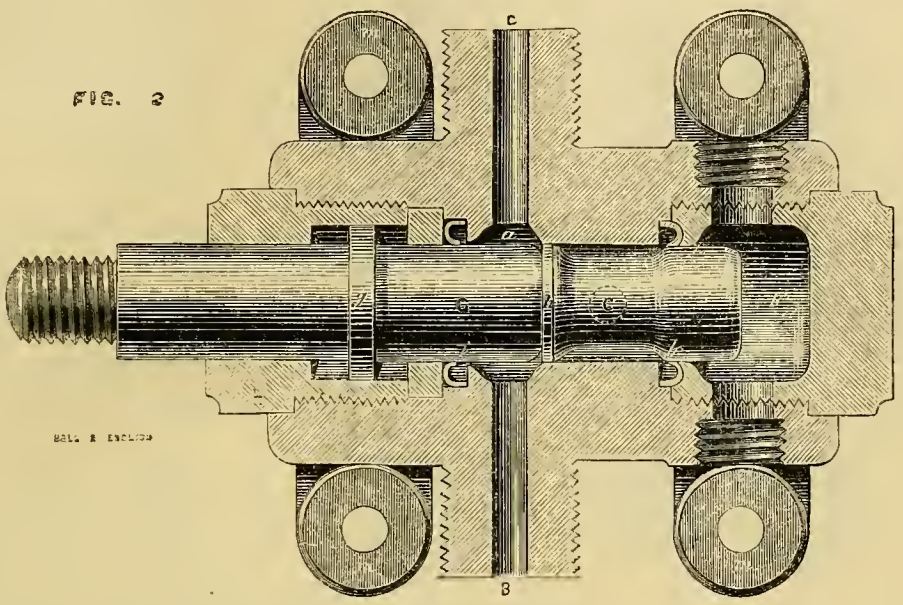

The great defect of nearly all water-pressure engines is the shock sustained in almost all forms of such engines at the change of stroke. It is not difficult to see that with certain modifications these valves present the means of more or less completely avoiding that. With these views we deem it well to produce the subjoined figures and description of Mr. Fenby's valves.

The employment of hydraulic pressure to many purposes, like that of steam, prior to the introduction of the slide valve, has been much curtailed for want of such a valve as shall give perfect con-

trol at very high pressures, with simple and rapid means of changing from "feed" to "exhaust," and *vice versâ*.

With these ends in view Fenby's hydraulic slide valve has been designed. Fig. 1 shows an end elevation of the valve. Figs. 2, 3, and 4 are plans partly in section. The valve consists of a cylinder A, provided with screw lugs, B, C, and D, and tapped holes

FIG. 2




E and F, for making the necessary joints with the feed and exhaust pipes of the press, pumps, and accumulator.

In the cylinder A is the ram or piston G, carrying the cupped leather *h*, and fitting in all positions the cupped leather *i*. The ram G, immediately in rear of the cupped leather *h*, is reduced in diameter, again increasing to its full size as shown. In addition to the cupped leather *i*, the cylinder A has the cupped leather *k*. In the gland L is a cylindrical chamber, in which the collar *g* moves, acting as a regulating stop for the motion of the ram G, on which the said collar *g* is formed in the solid. The mode of fixing is as follows :—One of the lugs B and D being coupled to the pressure pipe from the accumulator, and one of the holes E and F being coupled to the exhaust pipe leading to the tank of the pumps, the remaining lug B or D, and the remaining hole E or F, are stopped off or coupled to the corresponding parts of the next valve, where several form one series. The lug C (fig. 1) is coupled to the cylinder of the press in cases where the ram moves, and to the ram if the cylinder moves. The flat lugs *m* are for bolting the valve to a base plate or to the press.

In fig. 2 the valve is shown in a neutral position, as the cupped leather *h* closes the passage from the chamber *a* to the aperture in the lug *c*; while, at the same time, the end of the ram G, fitting the cupped leather *k*, cuts off communication between the press and the exhaust-chamber *b*, causing the press to maintain a state of rest.

In fig. 3 the valve is shown as admitting the feed to the press. The ram G, being moved as shown, brings the cupped leather *h* into the chamber *a*, opening communication between the pressure-pipe and the press; the plain end of the ram G still fitting the cupped leather *k* prevents any access to the exhaust-chamber *b*.

FIG. 3.

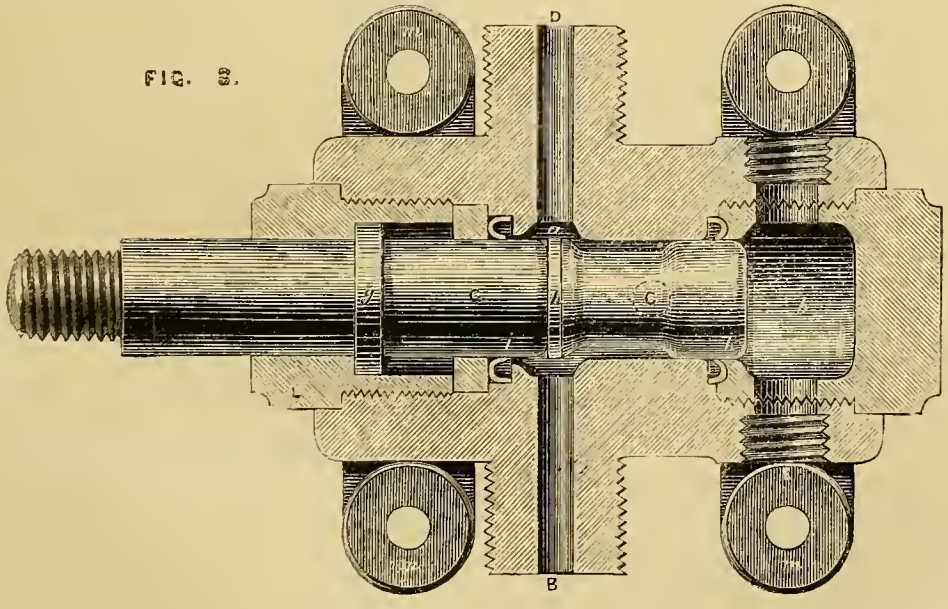
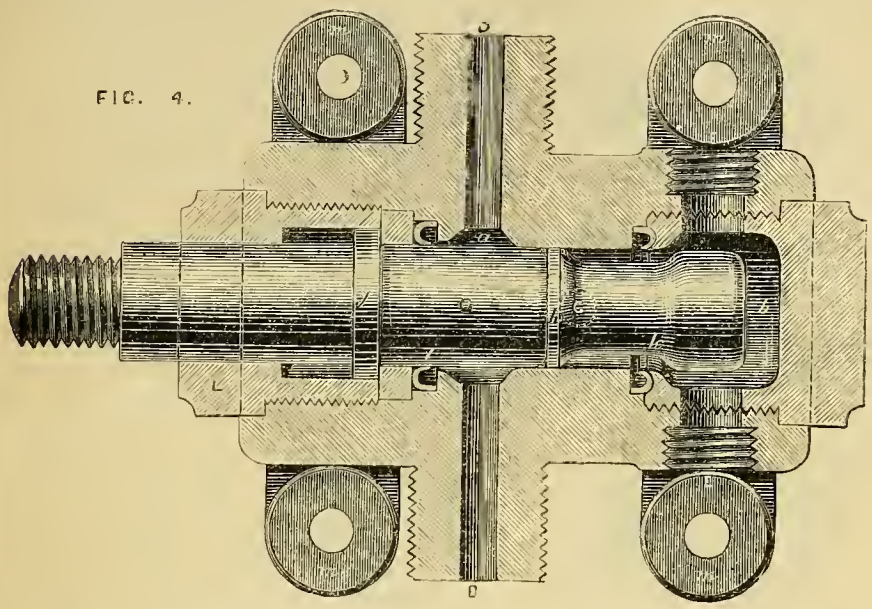



Fig. 4 shows the valve in a position open to exhaust. The cupped leather *h*, passing into the parallel part of the cylinder, cuts off the feed; and the valve, passing through the neutral position shown in fig. 4, brings the reduced part of the ram G through the cupped leather *k*, thus allowing a free escape of the water from the press.

As regards the speed attainable with these valves, it was found, in trying experiments as to the practicability of a hydraulic hammer, that at least 100 strokes per minute, for forging or punching, were easily attainable; in fact, the limit in speed lay in gear used for working the valve, and the supply by the pumps to the accumulator.

FIG. 4.



These valves are made in all sizes, from those engraved here to half scale—which are suitable for pipes from $\frac{3}{8}$ inch to $\frac{1}{2}$ inch bore—up to valves suitable for three-inch pipes. The material is gun-metal, and the valves are tested at a working pressure of 5,600 pounds on the inch. At this pressure the leather collars are found to stand well, one set of leathers having lasted three months under pretty constant use. They may be moved by hand or by power, and are *perfectly balanced. It is impossible to open both "feed" and "exhaust" simultaneously*, as is possible with various other valves at present in use.

## MANUFACTURE OF NITRO-GLYCERINE.

The mischievous and ill-considered Bill introduced this Session, the defects of which have been so well pointed out by our contemporary *The Engineer*, having now become law, the importation, or practically even the movement from place to place of nitro-glycerine will be illegal and impracticable after the 1st October next. That vast quantities will be introduced in the short interval from abroad, and hidden away, we may expect, and the probability of accidents worse than those this Act was meant to prevent; that, however, is not our concern. The material itself has already proved far too valuable, as applied to mining and quarrying purposes, for this meddling legislation to snuff it out. But the certain and rapid effect of it will be to compel the manufacture of nitro-glycerine in numerous localities, and close to very many places where it will be needed to be employed, in place of its being, as heretofore, purchased.

The result, we may pretty surely affirm, will be to increase largely the amount of general insecurity, and to multiply, instead of to diminish, the number, if not the gravity, of so-called accidents. Nitro-glycerine, made in large quantities by persons whose avocation is solely to deal with that explosive, and armed with adequate knowledge and experience, and from the very magnitude of their operations likely to take the utmost precautions that skill and science could suggest, is much less likely to be dealt with so as to explode "accidentally" than when manufactured by a sort of rough amateurs, often knowing almost nothing of the chemical or physical properties of the substances they are dealing with. So that this Bill avoids the danger of transporting or handling the material upon *long* distances, and substitutes the formation of innumerable new centres of its production, and the dangers of these, and of its carriage and handling for *short* distances—a notable case of precaution, truly! However, nitro-glycerine-making is pretty sure now, before another year or two is over, to become one of our domestic British industries; and our business is to make public as much information as to its manufacture as comes within our scope, so as to conduct it most safely.

We would direct our readers who may become interested, in the first instance, to the reports of the so-called Gun-Cotton Committee, who also reported to the British Association, as an index to a good deal of the information existing in foreign countries on the subject, and to Dr. Abel's several reports and memoirs, as to the researches of others, and recording his own important experimental investigations.

In the United States, nitro-glycerine, where used on great railway works in large quantities, has been made on the line of works, but made with complete and adequate apparatus, and under competent scientific direction. A paper was read at the end of last year, before the Polytechnic Association of the American Institute, by Dr. Pannalee, which well describes the process adopted for producing nitro-glycerine as employed for the blasting operations of the excavation of the Hoosac Tunnel. From this we take the following extracts:—

The nitro-glycerine is made at the laboratory constructed for the purpose near the shaft, under direction of Mr. George M. Mowbray, who has recently made some valuable improvements in its manufacture. They frequently make here 150 lb. daily. On entering the converting department of these works the first object that attracts the attention is a long trough, resembling a manger for feeding horses, about 3 ft. above the floor, and 50 ft. in whole extension, filled with ice and a little salt.

In this, about 2 ft. apart, are earthen jars holding a gallon each, their tops projecting 2 in. or 3 in. above the ice. In these jars are the nitric and sulphuric acids. Immediately over the jars, 2 ft. above, resting in a wood rack, are inverted cans, holding about one quart of glycerine. This drops into the acid below, where the reaction takes place, and nitro-glycerine is formed, which falls to the bottom of the jar. Mr. Mowbray agitates his acids with cold air. For this purpose he leads the cold air resulting from the partial expansion of compressed air into the laboratory through iron pipes, and over each jar of acid is a cock to which a rubber tube is attached. On the end of this is a glass tube. During the reaction in the jars, and while dense volumes of nitrous acid are evolved, and the heat which it is necessary constantly to keep down is rising, his men stir the mixture with these glass tubes, admitting a current of cold air, which agitates, cools, and in escaping carries off the gas it is so essential to get rid of, as soon as possible after it is formed.

The next part of the process is the removal of these jars, and the emptying of their contents through a trap or square opening in the centre of the floor, into a reservoir holding about 40 gallons of water, for the purpose of washing off all traces of acid.

After washing the nitro-glycerine, the reservoir, which is balanced on two journals, is turned over on its side gradually, and the nitro-glycerine emptied into glass and earthen receptacles. These are removed to the magazine, a few rods distant.

At the time Dr. Pannalee entered this magazine there were one thousand pounds of nitro-glycerine there in jars, holding from three to five gallons each, resting on benches.

Mr. Mowbray prepares his own nitric acid near by, and also concentrates the sulphuric acid he employs. It is probably by close attention to the qualities of the materials he employs, and the thorough agitation and carrying off of the nitrous acid gas, by the cold air introduced into the jars for this purpose, and also to prevent elevation of temperature, that he succeeds in obtaining the quantity and quality of nitro-glycerine he does. Forty-two pounds of glycerine yield him ninety-four pounds of nitro-glycerine, which, at a temperature of 48 degrees and upwards, is perfectly transparent and without colour. A little below this temperature it becomes frozen, and then resembles pounded ice.

The men who are obliged to breathe the smoke resulting from the explosion of the nitro-glycerine in the tunnel, informed the author that they experienced very little inconvenience from it; while formerly, when they used the imported article, which was more or less yellow and brown, they were affected with intense headache.

One physical difference, which will be appreciated by chemists, between that imported and Mr. Mowbray's make, is, that a 12 in. column of fluid nitro-glycerine, imported, will expand in freezing three-fourths of an inch in height, while that of Mr. Mowbray's shrinks half an inch. This is supposed to occur from the presence of nitrous gas in the one and an absence of it in the other.

Mr. Mowbray and the electrician, Mr. Brown, informed the author that they had made experiments with frozen nitro-glycerine; into which a tin tube was nearly

filled with the liquid, then frozen. Gun-cotton in one case was placed over it; in another fulminate, and in another gunpowder. To these were attached electric fuses, the tubes placed between heavy blocks of ice, and fired. The result was to drive the frozen nitro-glycerine out of the tube into the ice, in the form of a candle; no explosion of the nitro-glycerine taking place.

Mr. Mowbray, from this and other experiments, concludes that this agent may be transported quite safely in the frozen state.

We leave these statements as we find them. We must, however, notice that this assumed innocuousness of solid frozen nitro-glycerine is in direct conflict with facts stated in many places, and apparently upon quite competent authority. A miner in Germany, not above a year or two since, was stated to have been blown to pieces by striking a large block of frozen material with a sharp-pointed pick to break it up.—Ed.

## THE SO-CALLED "URBAN GUANO" OF ROME.

At an epoch when the agricultural interests are likely to be seriously affected by the diminution, from earthquakes and other causes, of the annual supplies in Europe of the valuable guano of Peru, and the consequent great increase of its price, our attention has been called to an analysis of indigenous guano by a celebrated Italian professor, which we are happy to submit to public consideration, the subject itself being one of such high national importance in regard to the increase of the fruits of the earth and the means of life.

We understand also that the Papal Government has granted to Mr. H. H. Parish (a retired diplomate, now living at Rome) two patents for utilising the excremeut both of the city and suburbs of Rome, and we can only wish that enterprising gentleman every success; yet, on comparing the analysis of the "Urban Guano" with that of Peruvian, as exhibited below, we cannot avoid being struck at the very small percentage of ammonia and phosphates (in the Urban Guano), two of the chief fertilising ingredients of Peruvian guano and other excreted manures; therefore we trust that Mr. Parish has tested the full value of his project before embarking much capital therein.

Table representing the Composition of Urban Guano in 100 parts, with respect to matters organic and volatile, inorganic or fixed, soluble or insoluble, in water :—

| Inorganic or fixed matters | | Organic and Volatile matters | | 100 parts of Urban Guano |
|---|---|---|---|---|
| Soluble matters . . . | 11·860 | . . 13·940 | . . Total | 25·800 |
| Insoluble matters . . | 33·340 | . . 40·860 | . . Total | 74·200 |
| | 45·200 | 54·800 | Total | 100·000 |

From the results inscribed on the present table, I conclude that the comparison between the organic and inorganic, soluble and insoluble matters, offers but little difference from that which is verified in the guano of Peru.

Without demonstrating the quantity of the matters which I have thought it necessary to value, I must observe that I have abstained from doing so in regard to sulphur, chlorine, sulphuric acid, magnesia, and alumen of iron, because I should have found them again in the quantitative analysis. They exist in the smallest portions; thus I cannot attribute to them any importance.

For the moment I shall place in comparison the quantities of the same matters, found by Boussingault in the guano of Peru of the best quality, and by me in the Urban guano :—

In 100 Parts.

| Of Peruvian Guano | | Urban Guano |
|---|---|---|
| Phosphoric Acid . . . | 15·24 | 1·204 |
| Nitric Acid . . . . | 0·19 | 0·343 |
| Carbonic Acid . . . | . . . . | 15 050 |
| Ammonia . . . . | 7·82 | 0·132 |
| Potash . . . . . | 2·56 | 0·031 |
| Soda . . . . . | 0·26 | 1·787 |
| Lime . . . . . | 13·33 | 21·310 |
| Silex and Sand . . . | 1·17 | 2,400 |
| Water . . . . . | 10·10 | 6·269 |
| Azote . . . . . | 13·40 | 2·252 |

Professor Luigi Guerri, Florence.

## A NEW RAILWAY-CARRIAGE.

Mr. Mac Cartney, of Glasgow, has designed a railway-carriage for passengers, which claims to possess many advantages over existing carriages. It is made of wrought-iron, and of a cylindrical shape—that being the strongest form into which a given weight of metal can be put—each part of the structure bracing another part, and forming a structure of much greater strength than the ordinary box-shaped or flat-sided carriages.

The interior of this carriage is cushioned at the sides and top, forming a soft surface to fall upon in case of accident; and this stuffing being made of non-conducting and non-combustible material, keeps the carriage warm in winter and cool in summer. There is, therefore, no danger of the carriage being burnt; and in the case of its being thrown off the line down an embankment, passengers will have cushioned surfaces to fall upon instead of the hard woodwork of the ordinary carriages.

The carriage is supplied with a door at each end, in the style of the American carriages, and the platform at the end, with the canopy above, are utilised as enormous and powerful buffers, to resist shock and gather up the momentum of a collision, while the ordinary spring buffers break the shock at starting and stopping.

The carriage beiug open at the ends affords an easy communication from one end of the train to the other, and hinders any possibility of outrage or attack by one passenger upon the other. There is afforded by this carriage an improved system of ventilation and heating, which will make it comfortable in summer and warm in winter, while for night-travelling, or for long distances, one of the carriages in the centre of the train can be adapted for a refreshment and smoking saloon, an advantage so much to be desired.

This slight sketch of the improved carriage will exhibit that the anticipated advantages to the travelling public are great, and may be summed up briefly as affording the greatest security against accident in the case of collision, easy and comfortable communication between passengers, guards, and driver, impossibility of damage by fire, comfort in summer and warmth in winter, and, above all, travelling will be made pleasant by reducing the vibration of the carriage to the minimum, and makes what in the present carriage is a pain and toil, in the improved, a pleasure.

To the railway companies the introduction of this carriage presents the following advantages:—The carriage is no heavier per passenger than the old; in fact, the number of passengers that can be seated in this, as compared with the old carriage, is somewhat greater; the cost of making is no greater, the danger to passengers being less; the compensation to injured persons will be proportionably decreased, while the damage to the carriage will be reduced to the minimum. Iron will last longer than wood, and can take as high a finish; the old carriages will always yield their price as old iron, while wood is only fit for the fire.

Of course there will be considerable opposition to the introduction of such carriages upon our lines of railway, but when such advantages can be shown, we think a trial of a train of such carriages would be the best way to test the matter, for at present the travelling public are afraid, and justly so, of being cooped up in compartments where for long distances they are completely at the mercy of all accidents, without any chance of comfort or hope of relief in case of danger.

## RELATIVE ILLUMINATING POWER OF DIFFERENT SUBSTANCES.

Taking as the unit of comparison the light given forth by the consumption in the usual form of lamp of one imperial gallon of Young's Paraffin Oil, Dr. Frankland has stated that to produce the same quantity of light 1·26 gallons of petroleum (*i. e.* natural oil) must be consumed. That also a total of light equal to either of the above is produced in burning by 18·6 lb. avoir. of paraffin candles, 22·9 lb. avoir. of sperm candles, 26·4 lb. avoir. of bleached wax candles, 27·6 lb. avoir. of stearine candles, or 39 lb. of tallow candles. The great economy of those liquid hydrocarbons is sufficiently evident, though there can be no doubt that

the deficiencies in luminiferous power of the candles is due in great part to their *being* candles, and not *liquids* burning with the advantages of a lamp.

But even this is not not all that can be said in favour of the liquids. The light-giving power of candles scarcely admits of any material improvement,—to increase the light is to increase the intensity of the heat of the flame, which is to swill and waste the substance of the candle. In the liquids, however, there is no mechanical or chemical difficulty in increasing the quantity of light, to an extent of which we venture to say no clear notion has yet been formed, by employing oxygen wholly or partly in place of atmospheric air as the supporter of the flame.

Now that oxygen can readily be obtained by means of permanganate of lime at a price low enough to admit of its domestic use, we do not know of a more fruitful-looking speculation for those engaged in the improvement of instruments of illumination than to devise a paraffin oil-burning portable lamp, with a portable supply of compressed oxgyen, to burn a known number of hours. The danger of using such a lamp, once properly constructed, would probably be less than that of the common camphine or petroleum lamps of the shops, for most of the accidents have arisen from awkwardness in upsetting these lamps in filling or lighting them, or with the oil-cans in filling. With oxy-paraffin oil lamps, the whole lamp should be delivered at the house of the consumer ready for use, and as with its oxygen reservoir it would be heavier and more bulky than the present lamps, so would it be safer as to upsetting, and accidents while filling put an end to. The same objections as against the blinding intensity of the focus of light in oxy-hydro carbon lights as respects their use in public places, do not apply to their use in apartments, where the light may and ought always to be above the eye and shaded.

When we consider what is done easily, habitually, and at a profit in Paris, in delivering about that city aërated water in "syphons" or gazogene bottles, and also frozen caraffas, *i. e.* bottles of common water solidified into a block for cooling other water or liquors, of which alone nearly half a million caraffas are said to be circulated daily in summer time in Paris, we see sufficient indications of what may be done at a profit in supplying from central depôts other domestic implements, such as those for giving light. It no doubt will occur to every one that such a project would find a powerful competitor in the existing gas companies; these companies however do, and no doubt will continue, as long as they can in their old jog-trot; they give, in London at least, gas of miserably bad illuminating power, and are not likely to attempt any radical methods of making it more luminiferous in the houses of the consumers. It does not follow that although cheap as gas, such as it is, may relatively be yet, measured by the light afforded for 20*s.* sterling, paraffin oil, well burnt with oxygen, might not give the same light much cheaper. This much is certain, that it would afford whatever illumination could be needed, in a far more wholesome way than it is obtained by the consumer of London gas. How it is that public checks and counter checks, and all the apparatus of public officers paid for testing and reporting upon the qualities of our London gas, seem to be costly methods of finding berths for officials whose reports have no result, and indeed seem to be generally of the mildest and most "how not to do it" character, we are too much outsiders to know or even guess. But from unhappy personal experience we can (through the winter) testify that the gas supplied to London and to the south side in particular, is such as ought not to be tolerated for a day, and such as would not be tolerated in Paris or Berlin, nor indeed in any capital but London, where genuine municipal jurisdiction and real action in such matters seems to be a succession of costly shams; or in New York, where it is said to be so corrupt, that bribery is the rule and can do what it pleases. Possibly, something of the sort even here is not unknown to gas manufacturers, and certain revelations of a year or two ago as to the surveillance of gas company directors over their own *employés*, were not calculated to add confidence to the public as to what goes on to influence the character of the final product which reaches their parlour gas-burners. The fact is, however, that London gas at the south side, and we believe it is not better in other quarters (unless in exceptional cases and at exceptional prices) is so loaded with impurities that silver plate left out upon a sideboard is tarnished brown in a single night of damp weather, and within a fortnight in winter becomes absolutely black with sulphuret of silver deposit, while the ammonia present is sufficient to eat through and through, any thin pieces of brasswork exposed above the gas flames in a very few months; gilding also is rapidly and irremediably tarnished by action upon the alloy in the gold, as the microscope proves.

To prattle of sanitary care for the public, and yet leave, or rather compel them, for they have no remedy, to breathe the air of rooms in which such gas as this is consumed and such products evolved, is monstrously absurd. Were the public once assured that they could obtain good and ample light from paraffin, which holds neither sulphur nor nitrogen compounds, to damage their health and their property, and at a cost not much exceeding that of coal gas, for equal yields of light, it would soon go hard with the present gas-making interests and gas-supervising philosophers, or all of them would have to mend their ways.

## MONITOR TURRET WITH WORKING MACHINERY AS FITTED IN THE ROYAL NAVY.

*(Illustrated by Plate XIII.)*

Our plate engraving for this month shows the method at present adopted in constructing and fitting the turrets for the reception and working of the heavy ordnance now employed in turret ships in Her Majesty's Navy. The arrangement will be clearly understood by the following brief description:—The same letters of reference refer to the same parts in each of the figures. A represents the armour-plating surrounding the turret; B the wood backing upon which the aforesaid armour is worked; C the skin plating to which the armour and backing are secured, and D the frames to which the skin plating is fixed, E being an iron skin on the inside of the turret; F is the slide on which the gun carriage runs, and G are chocks for raising and lowering the slide; H represents the beams at bottom of the turret; I chocks to which the roller-path is secured; J the iron roller-path, and K rollers and spindles which rotate the turret; L represents the brass castings to which the roller-spindles are secured; M iron rings in which the rollers work; N iron tubular castings, fixed to the deck around which the brass casting revolves; O is a wrought-iron tube fixed to the tube N, around which the turret revolves, and which is employed for handing up powder; P is a tubular casting to which bottom of turret is secured, and which revolves around the fixed tube O; Q is the engine for turning the turret, and R are handles for turning the turret when steam is not up; S is a ratchet in which cog-wheels T work for turning the turret; U is the apparatus for running the gun in and out; V buffer, composed of wood and india rubber, and W is a glacis plate surrounding the turret.

The method adopted for nipping the endless chain for running the gun either in or out, consists in the use of a short ratchet, secured to the side of the carriage, having teeth corresponding to the same pitch as the chain; a lever is fitted over it, to which is connected a compressor situated underneath the chain. By moving the lever, the compressor forces the chain up into the ratchet, by which means, when the chain is put in motion, the gun and carriage are run either in or out as desired.

## CHEAP SODIUM.

There can be no doubt, were this metal brought down from its present wholesale price, of about six shillings per pound, to what it might be probably produced at, viz., about the price of zinc, say about 2½*d.* per pound, that it would rapidly find a multitude of valuable applications in the arts and manufactures as a reducing agent. A new process for its production upon a large scale has been proposed, and, it is stated, is about being experimented with in apparatus of the proper magnitude.

This process is based on the following reactions:—

Felspar, or even flint, is brought to a white heat, and the dry vapour of common salt, produced by a current of hot air, blown through the salt kept in fusion, is passed through the silex, which is kept in motion; silicate of soda is formed, and chlorine evolved,

which is passed off to be used in making bleaching salts, &c. The silicate of soda is then mixed with an equivalent of lime and with charcoal, heated to a white heat, and carbonic oxide gas passed through it. A change of bases ensues ; silicate of lime is formed, and the soda, in presence of the reducing gas, passes off as sodium in vapour, which is then condensed in a succession of cooling chambers, and passed into some non-oxidizing liquid hydrocarbon—before being melted into pigs, which, when in this large bulk, as was proved by Messrs. Bell's experience at Washington Works, can be effected without difficulty, and with scarcely any loss by oxidation—in the open air, and just as we should operate with lead or tin or other more fusible metal.

There are some points about the process as described, which, even in a chemical light, are not clear to us, and, as to its first step, we do not quite see why the silicate of soda should not be made by direct fusion in the common way.

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## RECENT PATENTS.

### MACHINERY FOR TUNNELLING, SHAFT-SINKING, AND STONE-DRESSING.

JOHN DICKINSON BRUNTON, *Kentish Town.—Patent dated May 26th*, 1869.

This invention consists in substituting for the revolving discs, or for the sectors having bevelled cutting edges described in the specification of patents granted to the present patentee, No. 1784, year 1866, and No. 302, year 1868, a row or rows of cutting tools of a chisel form, and in acting upon these chisels by rollers or rotating discs, so as to cause them to chip pieces off the rock or stone.

The chisels may be so placed or arranged side by side, in a row or rows, as that their edges shall form a circle, either concave or convex, or so that their edges shall form a straight line, or any other figure that may be desired. The actuating rollers are to be fixed in the rim of a wheel suitably formed to receive them, or in a reciprocating bar, or they may be attached to the links of a chain, as may be found most suitable for the particular work required. In all cases each roller, as it fulfils its prescribed path, actuates each chisel, the several chisels being set in a firm and rigid holder.

In the construction of machines upon the principle of the tunnelling machine, described in the specification of the patent No. 1784, year 1866, but of a small size, suitable for boring holes for blasting, or for other like purposes, the patentee gives motion to the cutter chuck by means of an internal toothed wheel, placed at the outer end of the machine. Upon the rim of this wheel he forms a concave circular moulding, and in the concavity he forms a worm, or spiral of any desired pitch. By this worm or spiral he drives a worm wheel, and from thence gains the slow speed required for the orbital motion.

Figure 1 of the accompanying engraving is an end view, partly in section, of a portion of the improved tunnelling or shaft-sinking machine, in which the patentee substitutes chisels for revolving cutters. Fig. 2 is a back view of the same, looking towards the end of the tunnel, with certain portions removed to show the chisels more clearly ; *a a a* are the chisels, the edges of which form a circle, as shown in fig. 2 ; *b b* are the rollers, or rotating discs, which act upon the chisels *a a*, causing them to chip off the rock against which they act. A B are separate castings, bolted together by the bolts *c c c* so as to constitute a holder for the chisels. This holder does not revolve with the chuck C, but is held by the pins *d d*, while the machine is working ; it can nevertheless be moved round and set at different points, several holes being provided at the back of the casting B, into which the pins *d* will enter ; D is the cross head as described in the specification of the patent No. 1784, year 1866, before referred to, and E E are the pivots or arbors on which revolve freely the chucks C, which are driven by means of teeth cast on their peripheries, and forming one piece with the chuck C, as shown in section at fig. 1, and half in elevation at fig. 2 ; F is a casting made in two parts surrounding the cross-head, and bolted securely to the flange *e* cast upon the cross-head, in which casing are the pins *d d*, before described. This casing encloses the two wheels of the chucks C and the central wheel $C^1$, as described in the specification No. 1784, year 1866, which drives them both. As the cross-head moves slowly round, the chisels *a* slide inwards by their contact with the chip or surface acted upon, and are constantly forced outward again by the rollers *b* as they pass over or behind them.

Fig. 3 illustrates one method of employing the chisels in stone-dressing machinery. The chisels *a* are made either straight or curved (they are shown curved in the last named fig). Whether straight or curved, the chisels are actuated by rollers, which cause

Fig. 1

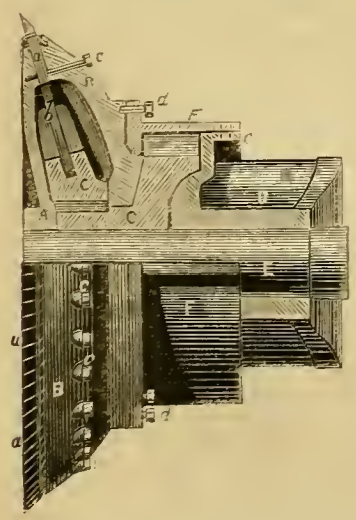
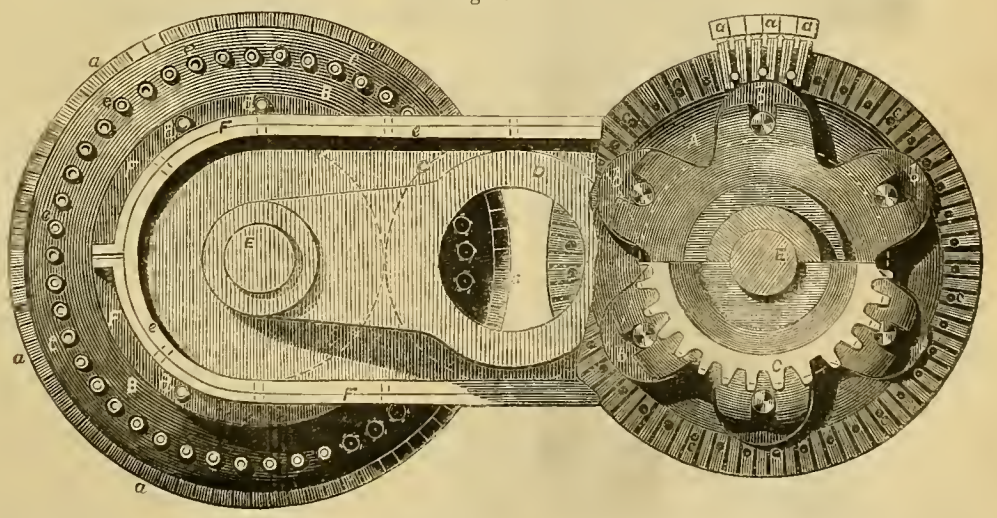
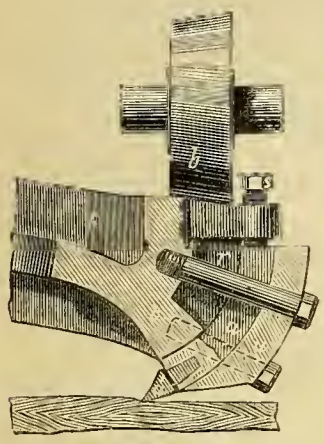


Fig. 2.



them to chip off the stone in front of their edges. The half of the chisel holder which contains the chisels has a rim *t*, with a semi ring *u*, bolted around it, leaving a space between *t* and *u* to receive the chisels *a*. The interior sides of this space are grooved to receive the projecting ribs formed on the wrought iron out of which the patentee makes the body of the chisels. The holder F is keyed upon a central pivot, and may be turned round by means of a worm-wheel and worm, so as to bring the chisels to bear upon either end of a stone placed upon a table.

Fig 3.



The chisels are formed of wrought iron, rolled to the required shape, and the inventor either welds steel points upon them, or he forms internal sockets in them, into which are fitted moveable points $a^1$, as shown in fig. 3. Between the head of the chisels and the roller *b* he places a short piece of hardened steel, and when the chisels become shorter by wear he makes up the proper lengths by intermediate pieces, or he fits to each chisel a piece *r*, shown in fig. 3, upon which the rollers *b* act, and which, by means of the set screw *s* upon the head of the chisel, impart their motion to the chisels; by means of these set screws, the chisels can be set to any desired point, and their shortening by wear may be compensated for.

Fig 4.

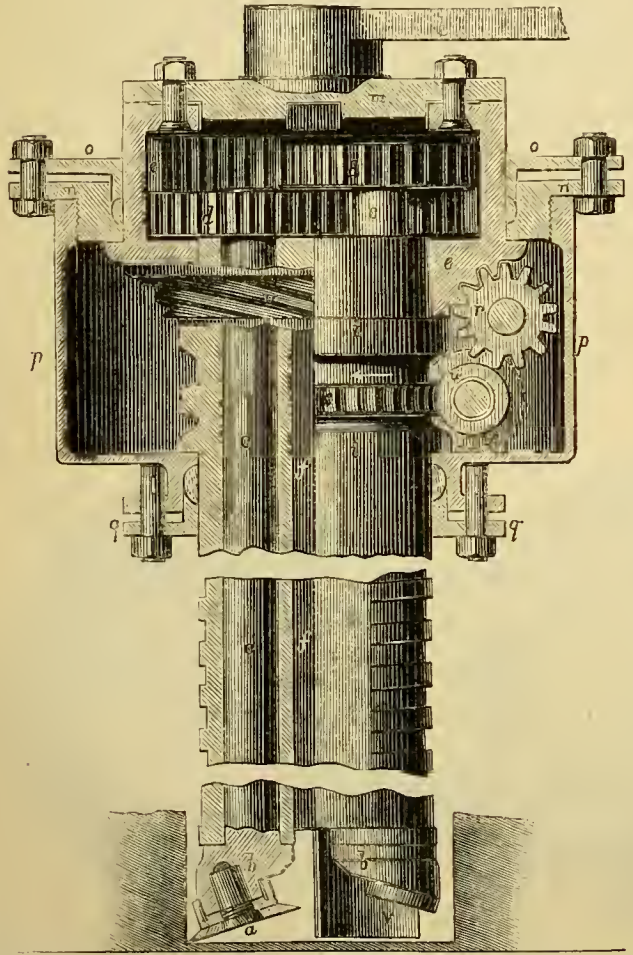


Fig. 4 shows a machine constructed upon the principle of the tunnelling machine described in the specification of the patent No. 1784, year 1866, for boring small holes for blasting or other purposes. The inventor uses only one cutting disc on each chuck, if the hole to be made is less than four inches diameter. The engraving represents a machine for boring holes three inches in diameter. *a* is the cutting disc; *b b* are the chucks, one in section, the other without the cutter. *c c* are shafts, each forming one piece with its chuck, and on the other end of which are toothed-wheels *d d*, which are driven by an internal wheel *e*. A is the stem of the machine, having holes through its entire length, through which pass the shafts *c c*, and a central passage *f*, through which water passes down into the hole for the purpose of washing up the débris; *g* is a collar with water-tight joint surrounding the stem, having a screw nozzle communicating with the water supply; *h h* are rollers, upon the lower end of the stem, to keep the machine centrally in the hole. Upon the upper end of the stem are formed two shoulders *i j*, and a worm-wheel *k*; upon the shoulder *i* rests the internal wheel *e*, which is turned round by a handle *l* fitted on a square cast upon the cover *m* of the wheel *e*. A shoulder upon this wheel bears the screwed collar *n*, with its packing gland *o*. The collar *n* screws into the outer casing *p*, the bottom of which is bored to receive the stem A; it bears up against the shoulder *j* and is made tight by a packing gland *q*. Upon the rim of the internal wheel *e* is formed a circular concave worm or spiral *v*, into which is geared the worm-wheel *r*. The revolution of the wheel *e*, with its worm or spiral *v*, gives motion to the wheel *r*, and this, by means of the wheels *s* and *t*, imparts motion to the worm *u*, working in the worm-wheel *k*, formed upon the stem.

By this means a slow rotation of the stem, similar to that produced in the cross-head of the tunnelling machine, as described in the specification of the patent, No. 1784, year 1866, is obtained. v is an s-formed partition to divide the stream of water as it descends through the passage *f*.

## MOTIVE POWER ENGINES AND STEAM GENERATORS.

John Henry Johnson, 47 *Lincoln's Inn Fields; a Communication from* Antoine Etienne Montigny, *Paris.—Patent dated April 15, 1869.*

The invention relates to a simple and economical construction of oscillating motive power engine suitable for driving sewing machines and performing other light work, and capable of being actuated by steam, hot air, compressed air, and other expansible gases; also, to a cheap and simple form of steam generator, with which the engine above referred to may be combined so as to form a portable engine and boiler complete. The improved steam generator may also be employed independently for driving other forms of steam engines. The essential feature of the improved motive power engine consists of a double-action oscillating cylinder worked with a given amount of expansion without the aid of a slide valve. According to one arrangement the full pressure steam (supposing that to be the agent employed) is first admitted on the piston rod side of the piston, which is of considerably smaller area than the opposite side, and, after having produced its effect thereon, the steam is cut off and is allowed to operate upon the under side of the piston by expansion only, when it ultimately escapes by the exhaust. The cylinder may oscillate upon a fixed stud at or near one extremity, in which stud the steam and exhaust ports are made, so as to communicate as required with the ports or openings in the cylinder; or the cylinder may oscillate in a hemispherical seat, or upon trunnions situate about mid-way along the cylinder.

Fig. 1 of the annexed engravings represents a vertical sectional elevation of one form of single cylinder double action expansion engine without slide valve; fig. 2 is a similar view taken at right angles to fig. 1. In figs. 1 and 2 *a* represents the cylinder, *b* a cylindrical socket, and *c* a trunnion which serves as the axis of oscillation. Within this axis is made the steam inlet passage *d* and the exhaust passage *e*; *f* is a branch passage leading from the inlet passage *d* and communicating with the lateral passage *g* on the side of the cylinder, with the upper end of which it communicates by the opening or port *h*; *i* is the exhaust port in the bottom of the

cylinder, and *j* is the branch passage which conveys the exhaust to the main outlet or exhaust passage *e*; *l* is a second port in the bottom of the cylinder, by which the steam enters beneath the piston, and *k* is an intermediate recess or channel made in the surface of the trunnion, in order to bring the port *l* into communication with the lateral passage *g*. A conical shoulder *m* is formed on the trunnion *c*, and a tightening or adjusting screw *n* is employed to make the working joint tight. The crank shaft rotating in the direction of the arrow, and the piston being at the top of its stroke, the inlet and outlet ports or passages are closed, but so soon as the fly-wheel has passed this point, the cylinder will incline to the right, and the steam from the boiler enters above the piston by the passages *d f* and *g* and port *h*. During this period of the stroke of the

Fig. 1.

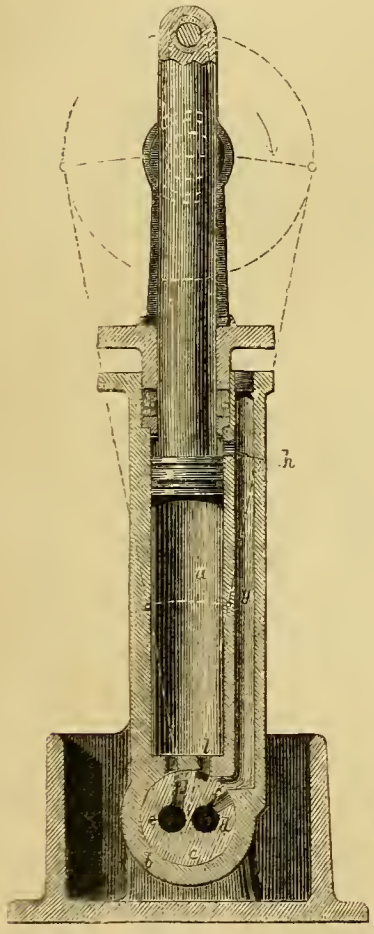
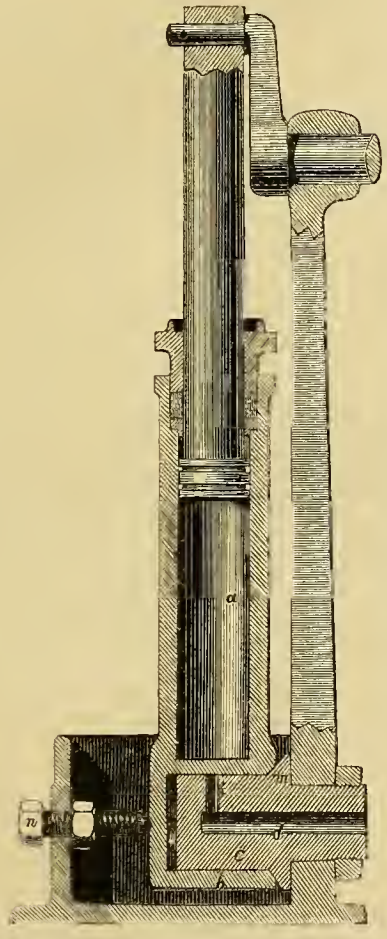


Fig. 2.



piston the lower capacity of the cylinder communicates with the atmosphere by the port *i*, orifice *j*, and passage *e*. When the piston has reached the bottom of its stroke the inlet and outlet orifices are again closed and remain so during the whole of the up-stroke of the piston. So soon as the latter has changed its position or passed the bottom centre, the cylinder inclines to the left and the channel or recess *k*, by establishing a communication between the lateral passage *g* and the port *l*, brings the upper and lower portions of the cylinder into connection with each other. The steam, which has previously been worked under full boiler pressure in the upper part of the cylinder, now expands with the lower portion and exerts its diminished pressure upon the full area of the under side of the piston, and thus completes the double stroke.

## LAW REPORTS.

Horse Clippers.—Salom *v.* Jassman.—Conrt of Chancery, before Vice-Chancellor Sir W. M. James, November 18, 1869. Mr. Fry, Q.C., and Mr. Solomon appeared for the plaintiff; and Mr. Eddis and Mr. Everitt for tbe defendant.

This was a motion for an injunction to restrain the defendant, who is a saddler in North Audley Street, from making and selling any horse clippers, in infringement of a patent granted to the plaintiff, an optician, in Regent Street, in March, 1868. The plaintiff's invention is a two-handled instrument formed of a knife or cutting plate of metal, fixed to a plate of metal edged like a comb, and constructed so that the knife in passing over the comb plate cuts off the hair. The defendant sells a similar instrument made under a patent invented by a Mr. Rawlings, and sold as Rawlings' Patent Horse-Clipper. The defendant denied the validity of the plaintiff's patent, and said that it was neither new in idea nor in combination. The motion for injunction was ordered to stand to the hearing of the cause, the defendant undertaking to keep an account.

Railway Signal Apparatus.—Saxby and another *v.* Mackenzie and others.—Court of Exchequer, Westminster; before the Lord Chief Baron, Mr. Baron Channell, Mr. Baron Pigott, and Mr. Baron Cleasby, November 19, 1869.

Mr. Grove. Q.C., Mr. Keane, Q.C., Mr. Macrory and Mr. Aston, appeared for the plaintiffs; the Solicitor-General, Mr. Webster, Q.C., and Mr. O'Hara Moore appeared for the defendants.

This was an action brought by the plaintiffs for an alleged infringement of their patent, dated June 24th, 1856, for Improvements in Railway Signal Apparatus. The action was tried before the Lord Chief Baron in June last, when a verdict was entered for the plaintiff on all the issues.

A rule for a new trial to enter the verdict for the defendants was moved for and obtained by the Solicitor-General, and came on to be argued some days ago, and the arguments have been resumed from time to time.

The defendants contend that they do not infringe the plaintiffs' patent, because they do not lower their signals by the action of the same lever that moves the shunting points, and simultaneous with that motion use another lever for that purpose. For the plaintiffs it was urged that the plaintiffs' invention consisted of apparatus by means of which the lever that works a shunting point, in order to open or shut a line of rails, also works the signals, and that in such a way that certain stops are interposed to prevent contradictory signals from being given, and the requsite stop is released to allow the proper indicating signal to be given. The plaintiffs' invention, it was said, was a system that for the first time, in 1856, provided the means of working railway signals with perfect safety. This was effected by causing the lever that moves the points at the same time to stop or lock up in a position indicating danger, all signals which, if lowered, would cause any collision or accident by permitting a train to go upon a line obstructed in any way by any point or other obstacle.

The defendants used, it appeared, the same mechanical means for moving a point and stopping contradictory signals; but they also used an additional lever to move the indicating signal, instead of allowing it to fall by the action of gravity, and contended on that account that their apparatus differed from that of the plaintiffs'. Their lordships reserved judgment.

Glass Furnaces.—Cannington *v.* Nuttall. — Rolls' Court, November 25; before the Master of the Rolls. Mr. Grove, Q.C., Mr. Fooks, Q.C., Mr. Theodore Aston, and Mr. Carpmael were for the plaintiffs; Mr. Webster, Q.C., Mr. Jessel, Q.C., Mr. E. Macnaghten, and Mr. Herschell for the defendant.

The trial of this patent case was concluded to-day. The plaintiffs, Messrs. Cannington, of the Vauxhall Works, Liverpool, have for some time past made use of glass furnaces constructed according to the specification of Pocheron's patent of 1866, of which they are the proprietors. Pocheron's process is a method of adapting the ordinary glass furnace to melting glass in bulk, by using a tank, or chamber, of firebrick, with a furnace at each end, and so dispensing with the pots in which the metal is ordinarily fused. As the pots, according to the evidence of one of the witnesses, last on an average some six or seven weeks only, while the tanks last as many months, this would seem to be a great improvement on the old process, besides the saving of expense which was occasioned by the constant cracking of the pots, which cost £7 or £8 each to make. In order to keep the sides of the tank cool and prevent the molten metal from oozing through the walls of the tank, M. Pocheron made the walls of his tank hollow, so that a current of cool air might circulate around the inner side of the tank, which thus stood, as a witness expressed it, in a basin of air. Some months before the filing of the bill the defendant erected at his works at St. Helen's a tank furnace, with a split bridge to admit heated air, which air was not carried, as in M. Pocheron's invention, round the tank, but was confined to the interval between the furnace at either end of the tank and the tank itself. The defendant's object in this was, he stated, to promote the fusion of the metal, and not, as in Pocheron's case, to protect the walls of the tank. The plaintiffs considered that their patent rights were being infringed by the use of this furnace, and instituted the present suit, which has now been tried by a jury at the desire of the parties.

The defendant denied the novelty as well as the utility of Pocheron's invention, and insisted that he had not infringed the patent. He adduced numerous inventions which, as he contended, were to a greater or less extent anticipatory of Pocheron's invention. He referred to the provisional specification of a Mr. Beatson for improvements in the construction of furnaces, as strongly resembling Pocheron's invention. Mr. Beatson, however, did not appear to have made any practical use of it, or to have proceeded beyond the provisional specification. A Mr. Richardson had used a reverberatory tank furnace for making bottles, for nine or ten weeks in 1836, after which the use of it was abandoned; and a good many witnesses were called with the object of impugning the utility of the patent.

His Lordship, in summing up, told the jury that they might dismiss from their minds any prior invention, of which the description was obscure, or which had not been reduced into beneficial practice. With regard to the novelty of the invention, every part of the combination might be old and yet the combination be new, and it was for the jury to say whether this was so in the case before them. It was not for them to say whether the plaintiff had been anticipated by the various inventors, on whose invention his Lordship proceeded to comment in detail. With regard to the charge of infringement, the chief question for them to consider would be, whether the split bridge used by the defendant was a material variation from the hollow bridge described in Pocheron's specification. Then he must tell them as a matter of law, that for any patent to be good, the specification must be such that a workman of ordinary skill can, from merely reading it, make the thing of which it is the specification. His Lordship then left it to the jury to say—first, whether the invention was new ; secondly, whether it was useful; thirdly, whether it was sufficiently described to enable a person of ordinary skill to use it; and fourthly, whether the patent had been infringed by the defendant.

The jury retired, and after an absence of about an hour, returned with a verdict for the plaintiffs upon all the issues.

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Breech-Loading Arms.—Norris *v.* The Birmingham Small Arms Company. Vice-Chancellor's Court, December 2, before Vice-Chancellor Sir R. Malins.

Mr. Theodore Aston (with whom was Mr. F. Harrison) moved to restrain the defendants from manufacturing certain arms, alleged to be an infringement of the plaintiff's patent for improvements in the apparatus for breech-loading arms generally. An inspection also was asked for. These arms were for exportation to Russia.

Mr. Cotton, Q.C., for the defendants, asked for security for costs, which being given, he offered to keep an account, but asked for time, the manager and secretary being in Russia.

After some discussion,

The Vice-Chancellor directed the motion to stand over for a fortnight without any terms as to inspection, the defendants keeping an account. It was impossible to decide a question of patent except upon affidavits on both sides.

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Supplying Air to Furnaces.—*Re* Yates' Patent. Court of Chancery, December 8, 1869, before the Lord Chancellor and Lord Justice Giffard. Mr. T. Aston appeared for Mr. Fletcher.

This was a petition to the Lord Chancellor for the sealing of a patent. Mr. W. Yates, on June 15 last, applied for letters patent for an improved method of supplying air to the fire of a furnace. The sealing was now opposed by Mr. Fletcher, who had obtained a patent for the same purpose on April 5 last. He had not opposed the granting of the patent to Yates when the matter was originally before the law officer of the Crown, but he explained this by saying that he did not know of the application till too late. He consequently, having no other course left open, opposed the petition of Yates to the Lord Chancellor for the sealing of the patent. The Lord Chancellor, when the matter came before him, referred it to the Solicitor-General to determine whether, under the circumstances, a patent ought to be granted to Mr. Yates. The Solicitor-General decided that Mr. Fletcher's invention, previously patented, was the same as that of Mr. Yates, and consequently that no patent ought to be granted to the latter. The matter now came on again to be mentioned, the decision of the Solicitor-General being conclusive on the merits.

Mr. Macrory, on behalf of Mr. Yates, only urged that his petition ought to be dismissed without costs. There was no suggestion of bad faith on his part; and, in fact, he knew nothing of Fletcher's patent till after the application for the sealing.

The Lord Chancellor saw no reason why the petition should not be dismissed in the ordinary way with costs. The person who failed ought to pay the costs.

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Tin-Foil.—Elmslie *v.* Boursier. Vice-Chancellor's Court, December 15, 1869, before Vice-Chancellor Sir W. M. James.

Mr. Grove, Q.C., and Mr. W. N. Lawson appeared for the plaintiffs, and were stopped; Mr. Willcock, Q.C., and Mr. Locock Webb appeared on behalf of the Defendant.

This was a suit for the purpose of restraining an infringement of a patent for improvements in machinery or apparatus for the manufacture of sheet tin by the importation from France of tin-foil manufactured according to the patented process.

The patent in question was taken out in March, 1859, by Mr. J. H. Johnson, as a communication from abroad by Jean Baptiste Ferdinand Masson of Paris. In May, 1851, the letters patent were assigned by Johnson (by the direction of Masson) and Masson to the plaintiffs, upon the distinct understanding, as alleged in the bill, that the plaintiffs should have the exclusive right of selling in England tin-foil according to the invention, and should be free from the competition of any persons manufacturing tin-foil in any foreign country according to the invention, under any patent or *brevet d'invention* then or thereafter to be granted to Masson. In 1865, the defendant Boursier purchased from Masson his manufactory and business, and all his patents or *brevets d'invention* for France, with notice, as alleged in the bill, of the understanding between the plaintiffs and Masson. This agreement, which was in the French language, contained among other provisions the following :—" A l'égard de tous autres pays, l'Angleterre exceptée, pour laquelle M. Masson a déjà pris un brevet, qui a été vendu par lui, et dont il est bien entendu qu'il conserve le prix intégral, M. Boursier pourra prendre à son profit, s'il le juge à propos, et si la législation de ce pays le permet, les brevets d'invention et d'importation." The defendant Boursier had imported into this country from Paris tin-foil, which was manufactured according to the process patented in England, and now vested in plaintiffs by assignment. The question argued was whether the importation and sale of articles manufactured abroad according to the patented process was an infringement of the patent, it being contended on behalf of the defendant that there had been no infringement, as the subject protected by the letters patent was the particular improvements in the machinery for rolling tin, and not the metal itself or any new combination of metal.

The Vice-Chancellor was of opinion that there had been a clear violation on the part of the defendant of the rights and exclusive privileges granted by the Crown to the patentee, and now vested in the plaintiffs. It was conceded that no one could use the plaintiff's process in England, and if it could not be done in this country it would be a very strange thing if a man, after parting with his rights over the patent in England, were to be allowed to sell the process in France, and enable it to be brought over here, so as to destroy all benefit of the grant of the letters patent. Being, therefore, of opinion that this obtaining from abroad and selling manufactured in this country tin-foil according to the plaintiff's process was an infringement of the patent, the plaintiffs were entitled to an injunction according to the prayer of their bill.

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## REVIEWS OF NEW BOOKS.

*Railway Economy: Use of Counter Pressure Steam in the Locomotive Engine, as a Brake.* By M. L. le Chatelier, Ingénieur-en-chef of Mines, &c. Translated by L. D. B. Gordon, F.R.S.E. &c. Edinburgh, 1869.

The title of this pamphlet, of nearly 70 pages, with illustrations, pretty fully explains its scope to those who know that "reversing steam," that is, turning on steam in the locomotive so as to drive the engine in the opposite direction to that in which it had been drawing the train—a thing long practised, and one occasionally not unaccompanied by danger when unskilfully practised by the engine driver—is not the same thing as working with counter pressure steam by which the whole load on the driving wheels is made effective in retarding the train.

This last, however, by the invention of M. le Chatelier, retards the train, not by the friction of the driving wheels, kept at work the wrong way, so to say, but by the power delivered back through the wheel-crank, connecting rod and piston, and equivalent in limit to that friction, converting the work of retardation into *heat*, which is in great part returned into the boiler, and so is not lost but stored up to be used again in traction.

The advantages are very great, very obvious, and very certain ; and, perhaps, we need not say more to induce the serious attention of our locomotive engineers and superintendents to it, than to say, that about one thousand engines are working under this arrangement in France, Spain, and more recently in Germany. No doubt the heavy gradients of most Continental lines make this effective, and in many ways economical method of retardation, more valuable than upon our level or slightly gradiented railways—*pro tanto*, however, it is as good here as there, and always equally good everywhere as an efficient auxiliary to rapid stopping, and hence avoidance of accidents. For details we must refer to the pamphlet itself, or to the original memoir published this year by Dunod, of Paris.

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*Five Hundred and Seven Mechanical Movements, &c. &c.* By H. T. Brown, Editor of the *American Artizan*. Trübner, London (dated 1870). Small 4to.

This is a small volume, full of very clear woodcuts of all those mechanical combinations or kinematic expedients for the conversion of one sort of movement into some other known more or less to all mechanicians. This is the old and long out-of-print volume of Lanz and Betancour in a new dress, with a large number of the "expedients" which the inventive abilities and the mechanical necessities of later years have drawn forth.

To the genuine mechanician, once he has studied all these "dodges" and contrivances right through, we do not think that such repertories of them as we have here are of much use ; no mechanic is ever at a loss to conveniently convert any mechanical movement in a concrete form into any other form that he may need. To the patent agent and lawyer it may be of more use occasionally, as showing them what "mechanical equivalents" were old at the date of this publication, which, with characteristic American "fastness," is dated 1870.

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*The Science of Arithmetic—a Systematic Course &c.* By J. Cornwell and J. G. Fitch. Small 8vo. Simpkin & Marshall, 1869. 2nd edit. The same authors whose "School Arithmetic" we lately noticed.

Amongst English works on our table is this, which seems to us no

better nor worse than the mass—for mass they are—of English educational books on the subject. But what *is* properly its subject? for we find mensuration lugged in, as if it were a part of scientific arithmetic; the book is too much padded out with examples, in great part useless unless to some incompetent teacher. Brevity is of the very essence of a good educational work; nowhere more so than in one to indoctrinate young people into the dry and desert places of figures.

However, this work does aim at what all ought, but few on the subject do, *viz.*, really carrying the understanding along in the laying down of rules for arithmetic computation—not teaching rules by rote—and the wisdom and importance of this are very well and ably developed and insisted on in a lecture by Mr. Fitch, one of the authors, *On the Method of Teaching Arithmetic*, delivered to the London Association of Schoolmistresses, and published as a pamphlet by Stanford, London, 1869.

*Ingram and Batley's Commercial Engineering Register.* Published by the Proprietors, Engineering Agents and Valuers, 8 Duke Street, Adelphi, London.

This is only a humble trade monthly circular, but one of great utility to all wanting or wishing to dispose of machinery or engineering plant or premises. The guaranteed circulation is stated to be 1000 copies per month, and it may be subscribed for.

*Illustrated Catalogue of Ice-Making and Refrigerating Machinery.* By Siebe Brothers, Engineers. London.

This catalogue is a remarkable illustration of the immense progress made within the last ten years, and still making, in the conversion of heat into power and thence into cold. Messrs. Siebe are the patentees of the Æther Ice Machines, and we learn that these are now getting into such extended use in breweries and for other manufacturing purposes, as well as for the production of ice in blocks, that ice machinery to the value of about £30,000 per annum is now manufactured by this firm alone. When we add to this, Mr. Kirk's air-refrigerating machinery in Scotland, and those of M. Carré, and of several others in France, we see that "cold making" has already become a great and extending trade.

## CORRESPONDENCE.

☞ We do not hold ourselves responsible for the views or statements of Correspondents.

TO THE EDITOR OF THE PRACTICAL MECHANIC'S JOURNAL.

Sir,—Being a subscriber of your Journal, I hope you will excuse my applying for information in the interest of housekeeping. It is regarding two new contrivances in the line of washing and of cooking, viz., a boiler, intended, or rather pretending, to clean linen without rubbing it. (Enclosed was an advertisement of one of the well-known washing machines.)

The other appears by the name of the "Norwegian Pot," in the advertising columns of our newspapers, and pretends to provide you a dinner with but little fuel and very little trouble; in fact, making dinner portable, to be served at any place you like, after certain hours allowed the victuals to cook themselves.

Presuming that you have heard of both the above-mentioned articles, I beg leave to ask your opinion on the subject, and would be glad to learn whether it is advisable to adopt them.

I am, Sir, yours very respectfully,

H. G. Schramm,
Maschinenbauer.

Hamburg,
November 11th, 1869.

There are two methods of clothes washing—the chemical, by which the foul matter is destroyed or dissolved, or both, by some menstruum, which perhaps always, more or less, destroys the fabric; even common soap and soda do so, though very slowly; and the mechanical, by which the foul matter, more or less rendered soluble, as by common hot water and soap, is detached from the textile fibres by rubbing or agitation in the water and washing away.

As a substitute for the unaided work of the washerwoman's hands, there are many contrivances, some of which upon a large scale operate very well. Perhaps amongst those for domestic use, none is better than that in which a number of hard wood balls are agitated amongst the clothes immersed in soapy water by means of a sort of dipping and revolving frame, also of wood, and moved by hand. Such implements are sold in many shops in London and elsewhere.

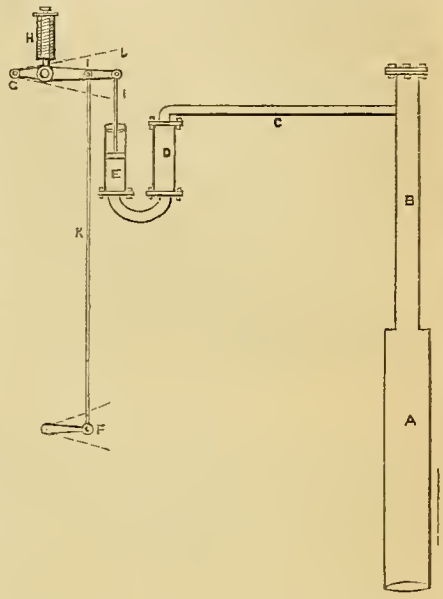
The Norwegian—so called—cooking kitchen, we apprehend as not much more than a toy. It is in fact a box arranged so that its walls shall be a very bad conductor of heat between inside and outside, and within which, by thus economising almost the whole of the heat evolved from a very minute source, such as a spirit lamp or a little ignited charcoal, the food is boiled or stewed—perhaps baked.—Ed.

TO THE EDITOR OF THE PRACTICAL MECHANIC'S JOURNAL.

Prestonpans, 22od November, 1869.

Sir,—In your remarks upon my last letter you asked me to furnish a plan of my float, and I now take the liberty of seoding one which I intended to send along with it, for on thinking over the matter I concluded I might be better understood by sending this one first.

Let the tube A be placed at the stern of the ship, where I would place it for the "float," and be made perfectly air-tight. Suppose the diameter of the screw to be six feet, which will be equal to the wide part of the tube, as shown in the sketch, the weight of a column of water 6 feet in height is equal to about 3 lbs. per square inch. When the water is exactly covering the screw, the pressure of the air in the tube will be 3 lbs. per square inch, and when the wave is going down the pressure of the air will go down at the same rate; when the screw is bare there will be no pressure in the tube. It must be borne in mind that it is only the pressure of the rising and falling of the waves travelling the diameter of the screw that we have to deal with; however high they may rise above, it matters nothing, as the steam will be full on at that point.




By leading the small pipe C (which in this sketch is shown too large) from the tube to the engine-room to the cylinder E, with a piston fitted into it pressing up against a lever working in a joint at the point G, H being a spiral spring adjusted to the pressure by a pinching screw, suppose the piston to have an area of 12 inches when the water is exactly covering the screw, the pressure below the piston being 3 lbs. per square inch, gives upon the area 36 lbs., raising it to the stop J, having opened the throttle valve full, and when the wave is leaving the screw, the spring will overcome the lessening pressure of the air till it reaches the stop I and shuts the throttle valve, the screw being bare and no pressure in the tube. F is the throttle valve handle worked by the rod K. D is an enlargement of the pipe C for holding oil, in the same manner as water is put into a steam gange; the oil will make the piston work with less friction, and help to keep it air-tight.

This plan could be simplified by placing the spiral spring upon the end of the piston rod, and the throttle valve rod to work through it, but as my object is merely to get you to comprehend my meaning, I have not shown full details in this sketch.

Whatever objections may be to either "this" or the "float," this one advantage made me bring them under your notice, *viz.*, their action precedes that of the engine, while that of the centrifugal governor is a secondary act of the engine.

Yours,
George Pringle.

## PROCEEDINGS OF SCIENTIFIC SOCIETIES.

### THE ROYAL INSTITUTION.

The Royal Institution Friday evening meetings are arranged to commence on the 21st inst. The evening discourses before Easter will probably be given by Professor Tyndall, Professor Odling, Professor Ruskin, Dr. Carpenter, Mr. Clifford, Professor Sylvester, Dr. Rolleston, Professor Roscoe, Professor Huxley, Professor Williamson, and Dr. Blackie. The Christmas lectures (adapted to a juvenile auditory) will be by Professor Tyndall, who has chosen Light for his subject: the first will be delivered on the 28th inst. at three o'clock. Arrangements have been made for the following courses before Easter:—On the "Architecture of the Human Body," by Professor Humphry, F.R.S.; on the "Vegetable Products of Chemistry," by Professor Odling, F.R.S.; on "Meteorology," by Mr. Robert Scott; on "Plant Life as contrasted to that of Animals," by Dr. Masters, F.L.S.; "Deductions from the Comparative Anatomy of the Nervous System," by Professor Rolleston, F.R.S.; an "Introduction to the Science of Religion," by Professor Max Müller; on the "Sun," by J. Norman Lockyer, F.R.S. After Easter, the following courses will be delivered:—"On the Principles of Moral and Political Philosophy," by Professor Blackie; on "Physics," by Professor Tyndall, F.R.S.; on "Astronomy," by Professor Robert Grant, F.R.S.; on "History," by Professor Seeley.

### THE INSTITUTION OF CIVIL ENGINEERS.

December 7th 1869.—The first paper read was on "The Public Works of the Province of Canterbury, New Zealand." By Mr. Edward Dobson, Assoc. Inst. C.E.

In this communication a history was given of the Public Works Department of Canterbury, from its establishment, in 1854, to the completion of the railways, in

1868. During that period the survey of the province, commenced under the "Canterbury Association," had been completed by the officers of the Survey Department; the eastern portion of the province had been thrown open to settlement, by the construction of many hundred miles of metalled roads; the western goldfields had been connected with the capital by a coach-road through the passes of the New Zealand Alps—a road remarkable both for the boldness of its design and the circumstances under which it was executed; and a complete system of railroad had been surveyed, the key to which (a tunnel 129 chains in length through the crater wall of Lyttelton Harbour) had been successfully completed. Extensive harbour works had been constructed, public buildings erected in the principal towns, and telegraph and postal services carried to a fair state of organisation. The total expenditure on public works and surveys during the period referred to had been, in round numbers, one million eight hundred thousand pounds sterling (£1,800,000), ont of a total Government expenditure of about two millions eight hundred and eighty thousand pounds sterling (£2,880,000). The whole of this outlay had been defrayed ont of current revenue, with the exception of about five hundred thousand pounds (£500,000), raised on debentures, secured upon the railways and upon the Land Fund. The population in 1854 was about 6,000; in 1868 it amounted to a little under 54,000, including the mining population of the county of Westland.

December 14, 1869—A Paper on "Ocean Steam Navigation, with a View to its further Development," by Mr. John Grantham, M. Inst. C.E., which was partly read at the meeting on the 7th inst., was concluded.

The Author stated that the object of this communication was, first, to take a review of the progress that had been made to the present time in Ocean Steam Navigation; and secondly, to draw from the examples thus collected some conclusions aa to its probable development in the future. We regret we cannot give space to the details of the paper.

## THE SOCIETY OF ARTS.

On the evening of Monday, the 6th ult., Mr. J. Norman Lockyer, F.R.S., delivered the first of a series of three lectures upon "Recent Solar Discoverica," in the hall of the Society of Arts, Adelphi Street, Strand, W.C. Every inch of available space was crowded by the audience, and a great many persons had to go away becanse, for want of room, they could not gain admission. The lecture was of a very elementary character, for which Mr. Lockyer stated that he was not to blame, as he had been asked by the council to assume that his hearers were unacquainted with the subject. After showing experimentally some of the properties of white light, he proved that it was composed of many colours, which fact causes illuminated objects to appear of different colours. In exemplification of this, he produced a yellow monochromatic light by the combustion of a lump of sodium in the flame of a Bunsen's burner; a diagram upon paper was then raised into view, and the design appeared to he composed of black and yellow colours. White light from the electric lamp was then suddenly directed upon the diagram, which was then seen to consist in reality of figures painted in many very brilliant colours. By simple though brilliant experiments of a like nature, he educated the audience in some of the principal facts connected with the phenomena of light, and gradually led them up to the principlea involved in the construction of the spectroscope. He also explained why an angle of 60 deg. is found to be practically the best to use in spectroscopic apparatus. The lecture was a short one, and everybody present seemed to be thoroughly pleased with its contents.

## THE LIVERPOOL POLYTECHNIC SOCIETY.

At a recent meeting of the above Society, Mr. Lander read a paper, of which the following is an abstract, entitled "Strength of Unstayed Flat Surfaces under Pressure."

The object of the paper was to lay before the Society some considerations that guided the writer in designing a digester under somewhat unusual conditions, for the firm of Messrs. Rose and Gibson, to be used in their new process of utilising cotton seed.

The conditions required to he fulfilled were that the bottom should be flat, that there should be no internal stays, and that it should be sufficient to withstand a working pressure of 30 lb. per square inch. The *factor of safety*, determined on from the natnre of the work to he performed, was the same as that in common use for steam-boilers, viz., 8. Thus, the bursting pressure is 240 lb per square inch. The method of strengthening the bottom by outside girders was selected in preference to bracing, for the sake of convenience with regard to the position it had to occupy. The distance of the girders from each other is one foot from centre to centre. The girders are proportioned so as to resist the entire pressure on the bottom of the vessel, each girder supporting a load of the amount of the pressure on a surface equal to the length by the distance between two girders. It is worth observing that the bottom of the vessel serves also for the top booms of the girders. The next point to be considered was the thickness of the bottom, to ascertain that it was strong enough between the girders to sustain the pressure without staying. The portion under consideration is evidently in the condition of a rectangular beam fixed at the ends, and is consequently simply under the laws which govern the breaking of beams. For calculation it is convenient and sufficient to consider a strip one inch broad stretching between the girders. The advantage arising from end fastenings being neglected, it is found that a very simple adaptatiou of the ordinary formula for the strength of girders leads to a general formula for surfaces under such conditions; $t$ = thickness of plate; $c$ = half distance between supports; $f$ = modulus of rupture — wrought-iron bars = 54,000; cast-iron bars = 33,000 to 43,500; W = bursting pressure on a strip unit breadth between snpports. $p$ = bursting pressure.

$$t^2 = \frac{c\,W}{\frac{2}{3}f}$$

$$\text{But } W = p \times 2c.$$

$$\therefore t^2 = \frac{p \times 2c.}{\frac{2}{3}f}$$

## MONTHLY NOTES.

The Volage.—The wooden-cased ship *Volage* concluded her measured mile trials recently. The *Volage* is a miniature *Inconstant*, cased in wood and copper sheathed, unarmoured, and built especially for speed. She is fitted with trunk engines of 600-horse power nominal, by Mesers. J. Penn and Son. The cylinders are 93½ diameter, and 3 feet 9 inch stroke. The trunks are 36½ inches diameter, the effective piston diameter being 86 inches. The average number of revolutions was 79 per minute. Pressure of steam 26½ lbs.; vacuum, 26½ inches to 27 inches. The indicated horse power was 4,657, or over 7¾ times the nominal power. The speed of the ship is 15 knots. The propeller is a two-bladed Griffiths, 19 feet diameter, and having a mean pitch of 22 feet 6 inches.

Ocean Steamships. — According to a statement recently published in the *Annales des Ponts et Chaussées*, the *Péreire* and the *Ville de Paris*, steamers of the Compagnie Transatlantiques, have, "in three years, conquered the sovereignty of the seas," eclipsing even the far-famed Cunard ships. Thus, in a voyage of 3,000 knots, the mean speed of the *Scotia* (Cunard line, paddle-ship) has been 12·32 knots per hour, with a consumption of 1,350 tons, whereas the mean speed of the *Péreire* has been 12·85 knots per hour, with a consumption of 850 tons of coal. The same paper shows that the screw is a cheaper and more efficient propeller than the paddle. The screw steamer, as compared with a paddle steamer of the same speed and capacity, costs less, weighs less, and consumes less fuel, and is much handier at sea. The Directors of the Compagnie Transatlantique have transformed their paddle steamers *St. Lawrent*, *Lafayette*, and *Washington*, into screw ships, and they intend to transform in the same manner the *Napoleon III.*, which was expected to be one of the finest and fastest of the fleet, but has not distinguished herself in any way yet. All the great navigation companies now order screw steamers.

A New Breakwater.—Mr. W. Jackson, of Windsor Street, Brighton, has invented an original arrangement in the construction of breakwaters. This consists of a sort of honeycomb formed by fastening together in parallel lines a large number of cast-iron tubes; the structure is so placed that the waves flow through the pipes, that is to say, the axes of the pipes are parallel to the direction of the most dangerous winds or currents. Mr. Jackson has recently submitted to the War Office a scheme for the erection of a small breakwater, according to his system, in Seaford Bay. He is not the first inventor of metallic breakwaters; Captain Vetch, R.N., invented, some years ago, a system of iron caissons, which he proposed for the Plymouth Breakwater; and in 1857, Lieut. Manico, R.N., patented an apparatus which he called also a caisson, though it would be more accurately defined as a crate, which he proposed to fill with stones, so as to form submarine blocks. Mr. Jackson's breakwater is widely different, however, from Captain Vetch's and Lieut. Manico's inventions. The latter are proposed to be used in the body of a pier or sea defence; the former, according to the inventor's ideas, should be placed at some distance outside. We have had no opportunity of seeing the tubular breakwater tested, though the inventor says he has erected one at Odessa, and that it has answered very well.

The Resignation of Colonel Boxer.—The *United Service Gazette* says:—"We are not at all surprised at the announcement recently made respecting the resignation of Colonel Boxer. We have full information as to the causes which have led up to this very sudden act, and which, when published, will, we imagine, create no little surprise in the public mind. Colonel Boxer, R.A., has occupied the position of Superintendent of the Royal Laboratory since 1855, and was therefore in the third period of his Staff service. His name is identified with that of the well-known 'Boxer Cartridge,' which has been so pertinaciously and unaccountably perferred in her Majesty's service to the cartridges of private inventors, even although the latter had been awarded the first prize by the Ordnance Committee." Does our contemporary mean that each one of the "private inventors" obtained a "first prize," or that the prize was divided among several? As far as we recollect, only forty-nine different sorts of ammunition were brought under the notice of the committee, and out of these the "only ammunition which the sub-committee conconsidered likely to fulfil the conditions of the War-Office advertisement was that submitted by Mr. Daw." Now as the Boxer cartridge, which the committee say in their report is undoubtedly the better of the two, was not allowed to be put into competition, and as the remaining forty-seven were disqualified, Mr. Daw had the battle all to himself, and very naturally won it—at least we always understood so.

A Scheme for Widening London Bridge.—Recently a petition was presented to the Lord Mayor and Common Council praying that the scheme of Messrs. Farren and Featherstonhaugh for widening London Bridge he taken into consideration. The proposers suggest that the caissons eqnal in width to the present piers should be sunk in front of the end of every pier, and as close to the cutwaters as their foundations will allow. On these caissons would be built piers and cutwaters, faced with granite ashlar, in courses exactly corresponding to those in the existing piers, so that when complete the piers would present a perfectly uniform appearance, but wonld be 40 feet longer than at present. These piers would carry iron girders exactly corresponding in form with the arches of the present bridge; some of the girders would be placed close against the face of each of the existing arches, altogether concealing the masonry faces of the present arches. Upon the girders carried by the piers a superstructnre would be formed, carrying the footpaths, parapets, lamps, &c., so that if the bridge were altered on this plan, it would finally appear as a granite and iron bridge with five arches. It would thus retain its present shape, approaches, and levels, and only to those passing under the bridge and looking up it would appear as a compound strncture. The roadway would in the event of the alteration, occupy the whole of the present width, and two 16 feet footpaths would be added. The estimated costs of such alterations, without highly ornate decorations, is £80,000.

APPLICATIONS FOR

# PROVISIONAL PROTECTION FOR INVENTIONS

## UNDER THE PATENT LAW AMENDMENT ACT.

☞ When the city or town is not mentioned, London is to be understood.

*2nd November* 1869.

3173 C. G. Gumpel, Leicester Square—Ships' rudders and steering gear therefor
3174 R. Spice, Cirencester Place, Fitzroy Square—Manufacture of artificial stone, and forcing liquids into porous substances.—A com.
3175 G. White, Queen Street, Cheapside—Metallic central-fire cartridge for breech-loading firearms.—A com.
3176 R. Davies, Liverpool—Machinery for transmitting motive power
3177 W. Connell, Glasgow, N.B.—Watercloscts
3178 A. H. Brandon, Paris—Motive-power engines.—A com.
3179 A. Wyllie, Stewarton, Ayr, N.B.—Manufacture of "Scotch bonnets"
3180 C. E. Cawley and J. Newton, Manchester—Improvements in tramways and in carriages to run thereon
3181 J. P. Hawley and E. Hill, Brixton—Apparatus for controlling the flow of water from constant supply pipes

*3rd November* 1869.

3182 S. Leoni, Saint Paul Street, New North Road—Apparatus for cooking and lighting by gas
3183 A. Grothe, Strand—Apparatus for registering the number of passengers travelling in or on public conveyances
3184 T. Wright and I. Fox, Nottingham—Apparatus employed in the manufacture or production of piles on net or lace or other fabric made on twist lace machines
3185 F. F. Samier and A. Anthoine, Paris—Metallic vessels intended to prevent all liquid or solid inflammable substances from igniting
3186 H. J. H. King, Glasgow, N.B.—Apparatus for measuring, indicating, and regulating the flow or passage of liquids
3187 T. S. Martin, Plymouth—Construction of self-acting stopcocks
3188 M. L. Winn, San Francisco—Apparatus for shampooing and washing the head
3189 N. W. Blanchard, Dutch Flat, California—Substitute for curled hair for upholstering and other purposes
3190 E. Snell, City Road—Compositions in imitation of marble, veneer, and other substances to be used in the manufactnre of fancy and other articles
3191 J. McDowall, Johnstone, Renfrew, N.B.—Machinery for sawing and otherwise cutting timber
3192 W. Gardner, Manchester—Tools for the manufacture of parts of watches or timekeepers
3193 G. Sinclair, Leith, N.B.—Treating wood and other vegetable fibrous materials for the production of paper pulp
3194 E. Finch, Chepstow—Dock gates and caissons

*4th November* 1869.

3195 J. Booth, Sheffield—Rolling or reducing metal
3196 H. Wilde, Manchester—Construction and working of electric telegraphs
3197 W. E. Gedge, Wellington Street, Strand—A novel vehicle termed 'the three-wheel velocimane.'—A com.
3198 M. Wilson, Wellington Street, Borough—Sink traps
3199 S. Busk, Pancras Lane—Bar iron for the manufacture of shoes for horses and other animals.—A com.
3200 C. de Ville Wells, Marseilles—Regulating the speed of marine steam engines when the screw is lifted ont of the water
3201 F. Armstrong, Paris—Sewing machines.—A com.
3202 A. Russell, Cheapside—Apparatus for making tucks or plaits applicable to sewing machines
3203 E. Edmonds, Rockville, Paignton, Devon—Coffee pot and filler for the same

*5th November* 1869.

3204 C. Crockford, Holywell, Flint—Treating metallic ores and materials and obtaining metallic and chemical products therefrom, &c.
3205 J. Maiden, Oldham—Lubricators
3206 J. M. Stanley, Sheffield—Furnaces and crucibles for melting steel and other metals, &c.
3207 J. Turnbull, Glasgow, N.B.—Cut-off gears for steam engines
3208 W. R. Lake, Southampton Buildings—Sewing machine needles—A com.
3209 J. K. Northall, Netherton, Worcester—Machinery for welding and finishing tubes
3210 F. Pash, Gracechurch Street—Bicycles or velocipedes
3211 A. M. Clark, Chancery Lane—Boring tools.—A com.
3212 R. Douglas and L. Grant, Kirkcaldy, N.B.—Motive-power engines

*6th November* 1869.

3213 F. Taylor, Nottingham—Sewing and embroidering machines
3214 H. Livesey, Blackburn—Polycycle rings or circular velocipedes
3215 W. R. Lake, Southampton Buildings—Securing stair rods.—A com.

*8th November* 1869.

3216 P. and A. Walker, Dalston—Gas meter
3217 T. Perkins, Hitchin—Apparatus for ploughing or cultivating land
3218 N. Shaw, Eau Claire, Wisconsin, U.S.A.—Generating steam in steam boilers, and protecting the grate bars in the furnaces under the said boilers
3219 J. C. Heywood, Royal Hotel, London—Weighing machines.—A com.

*9th November* 1869.

3220 J. V. Michaux, Hampstead—Securing corks in bottles.—A com.
3221 S. Heath, Walsall—Apparatus for clipping horses
3222 R. Aders, Manchester—Tinning of metals
3223 R. Jones, Birmingham—A special and general paper, card, or form holder, such as for address cards, envelopes, bill heads, &c.
3224 A. C. Kirk, Glasgow, N.B.—Retorts
3225 G. D. Davis, Woodstock Road, East India Road—Machinery for working rudders
3226 W. R. Lake, Southampton Buildings.—Machinery for heckling hemp.—A com.
3227 T. Hatterley, Leeds—Spindles and flyers used in the spinning and preparing of flax, tow, hemp, jute, worsted, wool, cotton, silk, &c.
3228 C. Mole, Tottenham Court Road—Manufacture of boots and shoes
3229 A. M. Clark, Chancery Lane—Transportation of letters, parcels, and other freight by atmospheric pressure

*10th November* 1869.

3230 J. and H. Tracy, Dalston—Stick or stem for umbrellas, parasols, whips and other handles
3231 A. Boblken, Varel, Oldenburg—Terriers
3232 E. Thomas, Aberdare—Miners' safety lamps
3233 W. Donbavand, Manchester—Balances for weighing
3234 J. Riley, Shoreditch—Roofs, and other parts of buildings
3235 G. Knighton, Riddings, Derby—Core barrels
3236 F. Jenkin, Edinburgh—Submarine telegraph cables
3237 J. W. Hackworth, Darlington Engine Works—Slide valves for steam engines
3238 J. Ingleton, Glasgow, N.B.—Watercloscts
3239 H. Lee, Manchester, Looms
3240 B. Doering, Victoria Street—Stand or carriage for rock boring or excavating machines
3241 I. and G. Battinson, Halifax, and T. and H. W. Whitehead—Machinery for combing wool, cotton, flax, &c.

*11th November* 1869.

3242 J. Logan and W. Gardner, Paisley—Ornamenting textile fabrics
3243 A. Mosley, Old Radford, Nottingham—Lace machinery
3244 H. Robinson, Skipton, York—Kilns for burning limestone, chalk, cement, or for calcining ores
3245 T. Herbert and J. C. Fowler, Leicester—Signalling between various parts of a railway train
3246 M. Tuthill, Mota Borrisokane, Ireland—Horse gear
3247 J. P. Budd, Ystalyfera, near Swansea—Manufacture of iron
3248 J. McCormick, Boston, Massachusetts, U.S.A.—Brewing malt, &c.
3249 I. Nasch, Berlin—Button-hole sewing machines
3250 W. R. Lake, Southampton Buildings—Combination locks.—A com.
3251 J. Guesne, Charlotte Street, Portland Road—Organ and piano combined
3252 G. Simpson, Glasgow, N.B., and L. Strauss, Wiesbaden—Apparatus for withdrawing beverages or other liquids from casks or other vessels, and for elevating the same
3253 J. M. Rowan and T. R. Horton, N.B.—Steam engines and boilers
3254 J. H. Johnson, Lincoln's Inn Fields—Treatment of caoutchouc, gutta-percha, and analogous gums for the production therefrom of articles of utility and ornament.—A com.
3255 J. Mason, Birmingham—Metallic pens.—A com.
3256 W. Harris, Birmingham—Locks and latches
3257 P. Wilson, Birmingham—Locks and latches, &c.
3258 H. Rochatte, Paris—Breech-loading firearms with central percussion
3259 G. A. Buchholz, Regent's Park—Machinery for hulling grain

*12th November* 1869.

3260 M. Benson, Southampton Buildings—Machine for dusting brand, &c.—A com.
3261 B. Shaw, Wakefield—Machinery for cutting soap
3262 S. Martin, Sheffield—Chairs for supporting the rails of rail and tramways
3263 C. Brakell, Oldham—Obtaining and applying motive power
3264 S. Chatwood and R. Kenyon, Bolton-le-Moors—Furnaces
3265 O. Rose, Bolton—Pistons for steam and other motive engines
3266 G. D. Edmeston, Preston—Hammers to be worked by steam or other elastic fluid
3267 W. Gorman, Glasgow, N.B.—Manufacture of iron and steel
3268 T. Snow, Inner Temple—Column for exhibiting notices at railway stations, &c.
3269 W. E. and F. Dobson, Nottingham—Production of shawls made on lace machines
3270 S. W. Shaw, Maidstone—Burning bricks
3271 H. R. Minns, Bristol—Letter pillar posts

*13th November* 1869.

3272 G. H. Hannaford, Finsbury Place South—Apparatus for working, locking, and controlling railway switches, points, and signals
3273 J. Edwards, Hackney—Permanent way of railways
3274 W. E. Gedge, Wellington Street, Strand—Composition or "electro-cathodic insulating mastic" to be used as a coating for preserving metal and other surfaces from the effects of humidity, and also as a cement.—A com.
3275 W. E. Gedge, Wellington Street, Strand—Machine for cutting, drilling, and shaping wood and metals.—A com.
3276 C. H. Holt, Manchester—Apparatus for obtaining blast in smelting and other furnaces
3277 R. Hardman, Ramsbottom, and G. Hardman, Newchurch, Lancaster—Carding engines
3278 C. Burgon and J. Ball, Sheffield—Manufacture of sheep shears
3279 R. Smith, Higginbottom, Manchester—Manufactnre of paper-hangings
3280 C. Sutton, Holloway Road—Ascertaining the presence of certain bodies which are concealed from view, and for discriminating between one body and another
3281 T. A. Dillon, Dublin—Safety lamp
3282 W. Richardson, Oldham—Valves of steam engine cylinders
3283 H. H. Grierson and J. M. Rigby, Manchester—Machinery for cutting or dressing stone
3284 J. Henderson, Bishopton, Renfrew—Treating certain ores
3285 C. D. Saintgeot and C. Poucel, Paris—Preventing and removing incrustations in steam boilers
3286 R. Ganthony, Richmond, Surrey—Inking or stamping pad

*15th November* 1869.

3287 P. Koch, Manchester—Knobs or handles of locks and latches of doors and gates.—A com.
3288 W. E. Gedge, Wellington Street, Strand—Box for matches, &c.—A com.
3289 F. Clarbour and W. E. Teale, Salford—Mining lamps
3290 F. Brampton, Birmingham—Locks
3291 F. Clark, Tamworth—Machinery for the manufacture of pipes, bricks, tiles, &c.
3292 C. D. Abel, Southampton Buildings—Refining and de-silvering lead.—A com.
3293 J. Tribe, Saint John Street, Smithfield, and J. Mallett, Charles Street, Saint John Street Road—Despatch boxes
3294 A. Gugla, Regent Street—Gloves
3295 W. Gossage, Widnes—Obtaining a certain compound of soda, &c.
3296 H. A. Bonneville, Sackville Street—Machinery for clipping horses, &c.—A com.
3297 G. R. Mather, Wellingborough, Northampton—Apparatus for cutting or giving form to wood
3298 J. G. Jones, Blaina, near Newport—Apparatus for breaking down coal

*16th November* 1869.

3299 G. Cherpit, Manchester—Healds for looms
3300 W. H. Tucker, Southampton Street, Strand—Locks
3301 W. Lancaster, Manchester—Furnaces
3302 W. Srigley, Burbage, near Buxton, Derbyshire—Friction engine
3303 M. Sautter—Reloading cartridge shell.—A com.
3304 H. H. Violet, Tours, France—Adherent stoppers
3305 C. Asbury, Balsall Heath, Worcester—Steam boilers
3306 J. G. Garrard, Bishop's Stortford, Herts—Buffers
3307 W. Nicll, jun., Bold, Lancaster—Blast engines
3308 J. Oppenheimer, Manchester—Telegraph posts
3309 F. Delacroix, Paris—Metallic manometer
3310 C. Ching, Castle Street, Long Acre—Boilers

*17th November* 1869.

3311 P. Negrin, Marseilles—Regulating the flow of liquids
3312 S. J. Mackie, Kensington—Floating vessels
3313 J. Crofts, R. Dawson, and J. King, Leeds—Combing wool
3314 T. Marshall, Glasgow—Composition for the prevention of fouling of ships' bottoms

3315 T. and H. Weston, Birmingham—Coating or casing of metallic tubes
3316 J. Willis, Sheffield—Umbrellas
3317 E. Bazin, Angers, and A. Ruiz, and Le Pelletier, Paris—Looms
3318 W. H. Perkin, Sudbury—Colouring matter

*18th November* 1869.

3319 K. Ogden, Manchester—Sarcophagus
3320 G. R. Sweetser and G. Wadman, Islington—Machinery for working wood
3321 G. Baron d'Adelswärd, Paris—Taking, still hot, the dross out of high furnaces
3322 J. Woodward, Manchester—Meters
3323 E. Körting, Islington—Feeding boilers
3324 C. Faure, Strand—Galvanic batteries
3325 J. P. Kerr and W. McGee, Paisley—Winding thread
3326 G. H. Kenworthy and T. Knowles, Ashton-under-Lyne—Preparing cotton &c.
3327 M. Shelley, Hoxton—Vent peg
3328 H. A. Hammond, Littlehampton—Chimney cowl
3329 G. Petrie, Rochdale—Manure
3330 T. Llewellyn, Great Portland Street—Squaring, planing, grooving, and rabbetting of wood

*19th November* 1869.

3331 S. Mendel, Manchester—Packing bales of cotton
3332 J. Dockray, Leeds—Drying, dressing, and finishing thread
3333 J. Hartley and Z. Sugden, Halifax—Boilers
3334 T. E. Lundy and J. L. Dunham, City Road—Means of communication between passengers in cabs, &c.
3335 G. F. Cornelius, Great Queen Street—Paint
3336 R. Clews, Dundee—Weaving
3337 R. K. Miller and A. B. Herbert, Edinburgh—Pumps
3338 J. Orson, Glasgow, N.B.—Geoffering and plaiting textile fabrics
3339 W. N. Mac Cartney, Glasgow, N.B.—Railway carriage.—A com.
3340 W. and M. Bayliss, Wolverhampton—Screws for the lower parts of fence, telegraph, and other posts
3341 A. M. Clark, Chancery Lane—Revolving battery gun.—A com.

*20th November* 1869.

3342 I. Hayford and J. F. Paul, Boston, U.S.A.—Wooden pavements
3343 W., J. and F. W. Edmondson, and R. Cunliffe, Manchester—Engraving cylinders used in printing
3344 C. D. Abel, Southampton Buildings—Utilising streams, subterraneau and other springs, lakes, ponds, and other surface waters, as motive power.—A com.
3345 J. Cochrane, Stourbridge—Tubes or conduits for the conveyance of letters, &c.
3346 H. Wilson, Stockton-on-Tees—Lubricating apparatus for steam engines
3347 B. Giuseppe, Milan—Vertical boiler
3348 L. Folliet, Paris—Grease box
3349 J. Taylor, Wigan—Furnaces
3350 J. Bélicard, Manchester—Metal healds
3351 T. Aitken, Holmshore, near Manchester—Washer cloth
3352 W. Templett, Union Street, Borough—Banjos, &c.
3353 T. R. Hetherington, Manchester—Spinning and doubling cotton
3354 D. Morgan, Burntisland, N.B.—Lubricating oil
3355 T. F. Lynch, Aldersgate Street—Bottles
3356 S. H. Salom, Regent Street—Shearing the hair of horses
3357 A. B. Childs, Mark Lane—Cleaning, sconring, and decorticating wheat
3358 W. R. Lake, Southampton Buildings—Distributing type.—A com.
3359 J. H. Fraser, Bromley-by-Bow—Boilers
3360 S. L. Loomis, South Byron, U.S.A.—Sash tightener
3361 Sir J. Macneill, Kensington—Lucifer match and fusee boxes
3362 J. Moseley, Newcastle-upon-Tyne—Warming feet
3363 J. Burroughs, jun., Newark, New Jersey, U.S.A.—Electro-magnetic machines

*22nd November* 1869.

3364 R. Wilson, Patricroft, near Manchester—Hydraulic presses
3365 S. W. Wilkinson and J. E. Dooley, Stockport—Pillar post-office, &c.
3366 G. H. Wilkes, South Hackney—Supporting clothes lines
3367 J. Bourne, Birmingham—Gauges
3368 J. Bottomley, Bradford, and S. Emsley, Low Moor, near Bradford—Spinning fibrous substances
3369 J., J. and H. Ingham, Thornton, near Bradford, and C. Smith, Horton, near Bradford—Shuttles
3370 R. Hennell, Sussex Gardens—Pavements
3371 F. Hawkings, Harrow Road—Fire-escapes
3372 G. Ritchie, Lewisham Road, Kent, and J. Ritchie, Barnsbury—Tents
3373 J. Tomlinson, Carlisle—Cements
3374 J. Brookes, Birmingham—Fastenings applicable to ladies' stays, &c.
3375 E. E. Allen, Brompton—Tramways

*23rd November* 1869.

3376 H. A. Bonneville, Sackville Street, Piccadilly—Steam-boiler supply cock.—A com.
3377 H. A. Bonneville, Sackville Street, Piccadilly—Electro-metallurgy.—A com.
3378 H. A. Bonneville, Sackville Street, Piccadilly—Electric batteries.—A com.
3379 S. G. Arnold, Providence, Rhode Island, U.S.A.—Saws
3380 J. E. Crocé-Spinelli, Paris—Nautic means and apparatus
3381 E. Round, Sheffield—Indicator
3382 W. E. Gedge, Wellington Street, Strand—Hydraulic traction on railways, &c.—A com.
3383 H. F. Shaw, West Roxbury, Norfolk, Massachusetts, U.S.A.—Cutters for moving machines
3384 A. Nairn, Leith—Steam carriages
3385 P. Foster, Islington—Pressure gauges
3386 J. H. Johnson, Lincoln's Inn Fields—Grinding saws.—A com.
3387 H. C. Löbnitz, Renfrew, N.B.—Motive-power engines

*24th November* 1869.

3388 A. McNeill, Liverpool—Safe for ships, &c.
3389 F. J. Granville, Glencruitchery, Douglas, Isle of Man, and H. Gardner, Liverpool—Advertising sheets
3390 W. Thomas, Llanelly—Obtaining power
3391 J. Fogg, Edgeworth, Lancaster—Dressing flags and stones
3392 S. Cotton, Belfast—Preparing flax, hemp, &c.
3393 J. Norris, Manchester, and Longworth, Winewall, near Colne—Placing fog signals upon railways
3394 J. Dunkerley, Audenshaw, Lancaster, and E. Dunkerley, Stockport—Felting or "planking" the bodies of hats, bonnets, &c.
3395 J. B. Paddon, Hove, Sussex—Gas
3396 D. Miles, Boston, U.S.A.—Lighting and extinguishing gas by electricity.—A com.
3397 J. Turnbull, Edinburgh—Connecting and disconnecting carriages and waggons on railways
3398 S. Chatwood, Bolton, and T. Sturgeon, Manchester—Forcing and drawing fluids and liquids
3399 M. Henry, Fleet Street—Transporting railway carriages and other heavy bodies from place to place
3400 J. Downs, Kingston-upon-Hull—Hydraulic presses used for seed-crushing
3401 W. C. Mann, Leeds—Hats

*25th November* 1869.

3402 P. C. Evans, Brimscomb Mills, Gloucester, and H. J. H. King, Glasgow—For feeding wool, cotton, or other fibrous materials to carding or other machines
3403 F. W. Webb, Bolton—Steam engines and boilers
3404 T. Richardson, Manchester—For an invention of improvements in the compound forms and desks or tables for schools
3405 J. Nichols, Pendleton—Polishing yarns and threads
3406 B. Goddard and W. Finley, Stockport—Pill making, &c.
3407 E. F. Goodall, Birmington—Ink bottles
3408 W. R. Lake, Southampton Buildings—Propelling ships.—A com.
3409 B. Johnson and E. B. Ellington, Chester—Hydraulic cranes
3410 A. McDougall, Manchester—Blacking
3411 T. Brown, Newgate Street—Drilling or boring rocks.—A com.
3412 L. Mount, Bromley by Bow—"Filling" match splints
3413 J. Keats, Leek, Stafford—Buckle
3414 G. M. Felton, Well Street—Collars
3415 W. E. Gedge, Wellington Street, Strand—Powder for destroying the oïdium in vines and other plants.—A com.
3416 W. Pollitt and W. J. Knowles, Blackburn—Churning and mixing fluids

*26th November* 1869.

3417 D. Barker, Northfleet—Varnish paints
3418 J. Denis, Great Dover Street—Producing pulp from wood and other fibrous substances for the manufacture of paper
3419 J. Fletcher, senr. J. Fletcher, junr., and W. Fletcher, Salford—Mortar mills
3420 S. Tatton, Leek, Stafford—Bobbins
3421 S. Tatton, Leek, Stafford—Card for facilitating the withdrawal of single threads for sewing purposes
3422 E. H. Burke, King's Bench Walk, Temple—Metallic barrels
3423 B. Wood, Foundry, near Stourbridge—Lids for railway axle boxes
3424 W. Perkins, Heruc Hill, Surrey—Matches, &c.
3425 J. Combe, Belfast—Hackling flax
3426 A. C. Engert, Tabernacle Row—Ornamental placards
3427 J. Brunton, Kensington—Working and locking railway points and signals
3428 S. Wyatt, Plymouth—Preservation of meat

*27th November* 1869.

3429 H. S. Freeman, Fenchurch Street—Adjustment of men's wearing apparel
3430 F. Preston, Manchester—Preparing, spinning, twisting, and doubling wool, &c.
3431 W. C. S. Percy, Manchester—Cutting animal and vegetable substances
3432 A. Barclay, Kilmarnock—Condensers
3433 G. Bertram, Edinburgh, and M. Patterson, Ivy Bridge, Devon—Straining paper pulp
3434 J., J., E. and W. Pitt, Cleckheaton—Cutting and shaping metals
3435 L. Pochet, Vendôme, France—Cutting or dressing stone
3436 W. Johnson, Gough Square—Lock
3437 J. Howard and E. T. Bousfield, Bedford—Cutting standing crops
3438 A. E. Loram, Birmingham—Buckles
3439 W. Cross, Glasgow, N.B.—Shawls
3440 G. Lockett, Red Lion Square, Holborn—Revolving graphoscope
3441 W. Brookes, Chancery Lane—Sewing machines.—A com.
2442 B. Oldfield, Coventry—Looms
3443 S., J. J., and L. H. Perry, Red Lion Square—Boxes
3444 S. Fox and J. Reffitt, Leeds—Boring, turning, and polishing treenails

*29th November* 1869.

3445 J. Moseley, Manchester, Calico printers' blankets
3446 G. B. McFarland, New York, U.S.A.—Rotary engine
3447 E. Lethbridge, Benson, Oxford—Balancing millstones
3448 J. Williams, jun., Chelsea—Apparatus for cooking
3449 J. Tester, Hurst Green, Sussex—Cutting chaff
3450 E. Oades, Egham, Surrey—Vent plugs
3451 T. Reissig, Manchester—A new derivative of phenol
3452 J. C. Mewburn, Fleet Street—Obtaining motive power.—A com.
3453 H. Draper, Bebington, Cheshire—Tanning hides
3454 G. and A. B. Marquis, Glasgow, N.B.—Cutting or dividing metal
3455 J. Edwards, Farrington, near Preston, and J. Quin, Leyland, near Preston—Carding cotton, &c.
3456 W. R. Lake, Southampton Buildings—Journal bearings for railway carriages.—A com.
3457 W. Parham, Bath—Buildings
3458 J. Speight, Bradford—Spinning, twisting, and roving worsted, &c.

*30th November* 1869.

3459 W. H. Shaw and J. M. Audus, Elland, near Halifax—Dressing millstones
3460 J., J. and W. H. Wood, Hollinwood, Lancaster—Ventilating hats, &c.
3461 C. H. Hudson, New York, U.S.A.—Bedsteads
3462 E. T. Hughes, Chancery Lane—Elliptic springs.—A com.
3463 A. W. Pocock, Pimlico—Meters
3464 W. H. Willis, Long Acre—Registering or indicating the points of games
3465 B. Acton and J. Mustard, Strond—Feeding carding engines
3466 W. Avery, Redditch—Umbrellas and parasols
3467 E. Ensor, jun., Woodville, near Burton-on-Trent—Kilns
3468 A. V. Newton, Chancery Lane—Converting reciprocating motion into rotary motion.—A com.
3469 R. Milburn and T. Browning, Whitechapel—Drying machines
3470 J. F. Crease, Eastney, Southampton—Tank filters
3471 R. Hornsby and J. E. Phillips, Grantham—Reaping and mowing machines

*1st December* 1869.

3472 W. Spence, Quality Court—Soda crystals.—A com.
3473 T. G. Green, Church Gresley Pottery, Derby—Manufacture of articles of earthenware, &c.
3474 J. Forbes, Perth—Desiccating malt, &c.
3475 J. James, Princes Street, Stamford Street—Marking letters, &c.
3476 A. C. Henderson, Charing Cross—Shearing or clipping animals.—A com.
3477 J. T. Griffin, Upper Thames Street—Preparing, treating, and curing sponge.—A com.
3478 W. Bennett, Aston, near Birmingham, and J. Currall, Birmingham—Kitchen ranges
3479 F. N. Target, Colyton, Devon—Waterclosets
3480 J. Peirce, Stamford Street—Compound machine for cutting tenons and mortises and sawing wood
3481 W. Richards, Birmingham—Firearms and cartridges
3482 H. C. Ash, Oxford Street—Churns
3483 R. Robey and J. Richardson, Lincoln—Steam engine governors
3484 R. N. Slight and W. F. Denholm, Chirnside Bridge, Berwick—Straining of paper pulp
3485 G. Hammer, Reutlingen, Wurtemberg—Cork-cutting machines

*February, 1870.*
Practical Mechanics Journal.
*Plate, XIV.*

# DIRECT-ACTING ICE-MAKING MACHINE,

SIEBE, BROTHERS, LAMBETH.

ENGINEERS.

Third Series
*Vol. 5.*

FIG. 1.

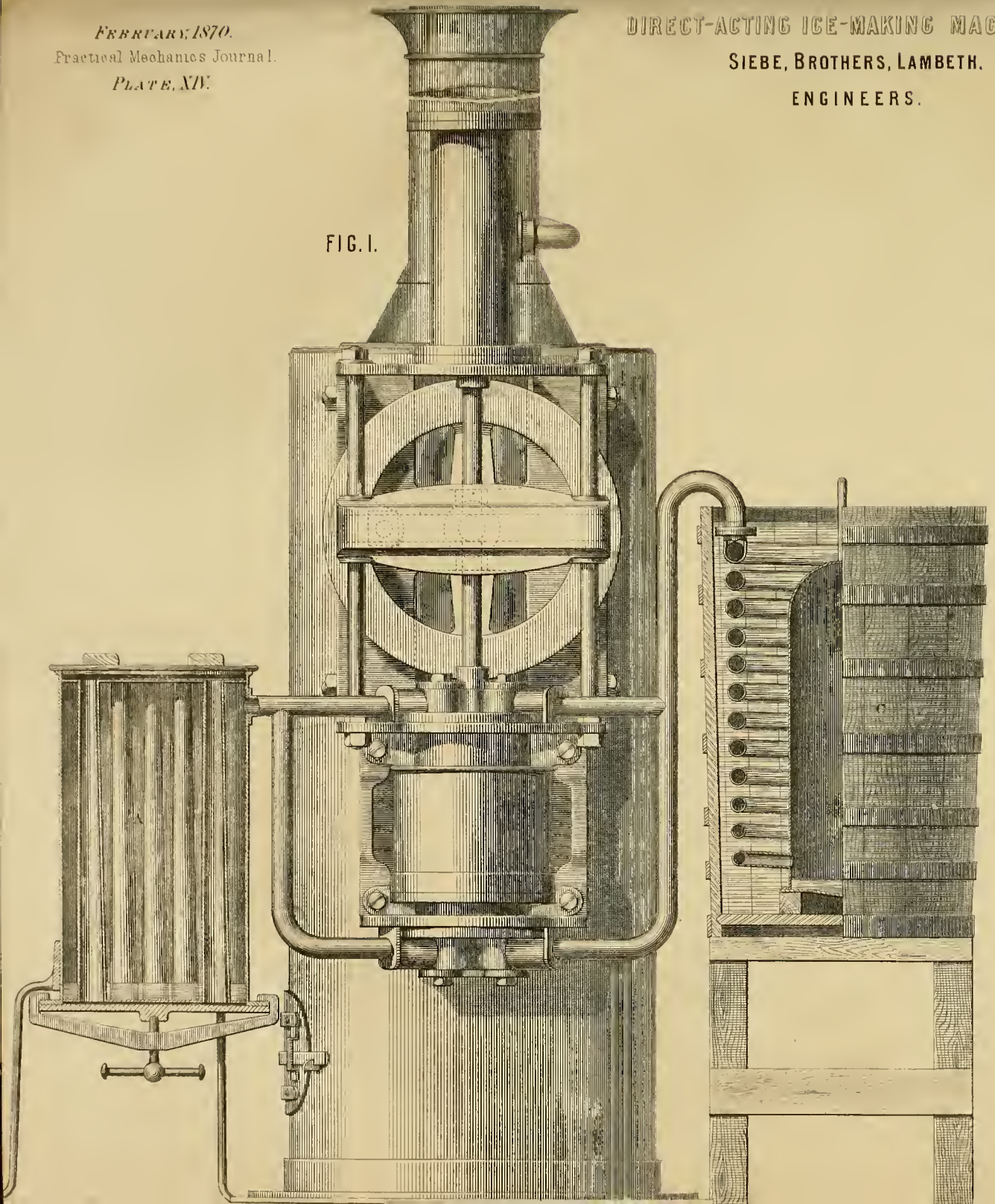


FIG. 2.

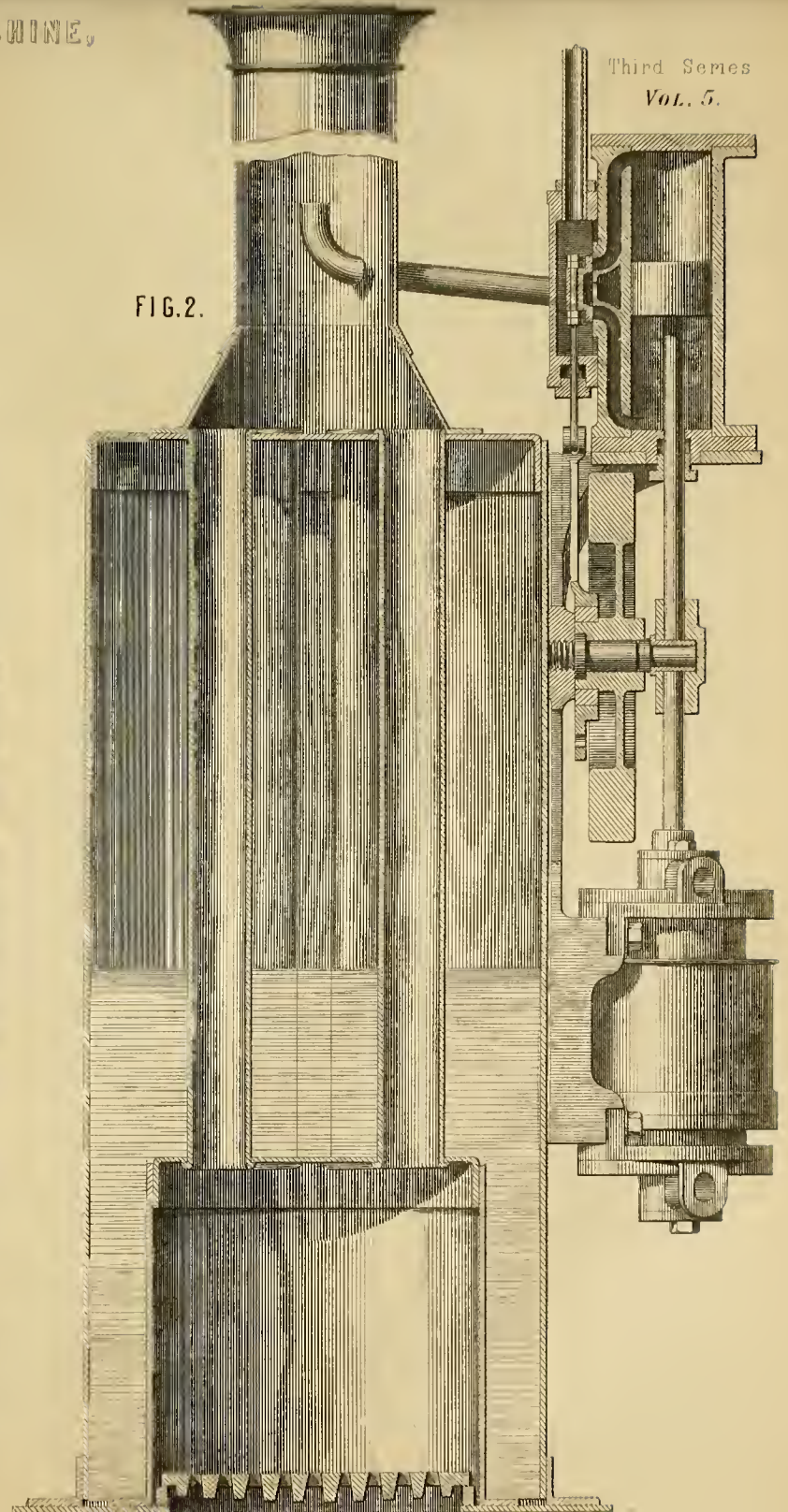
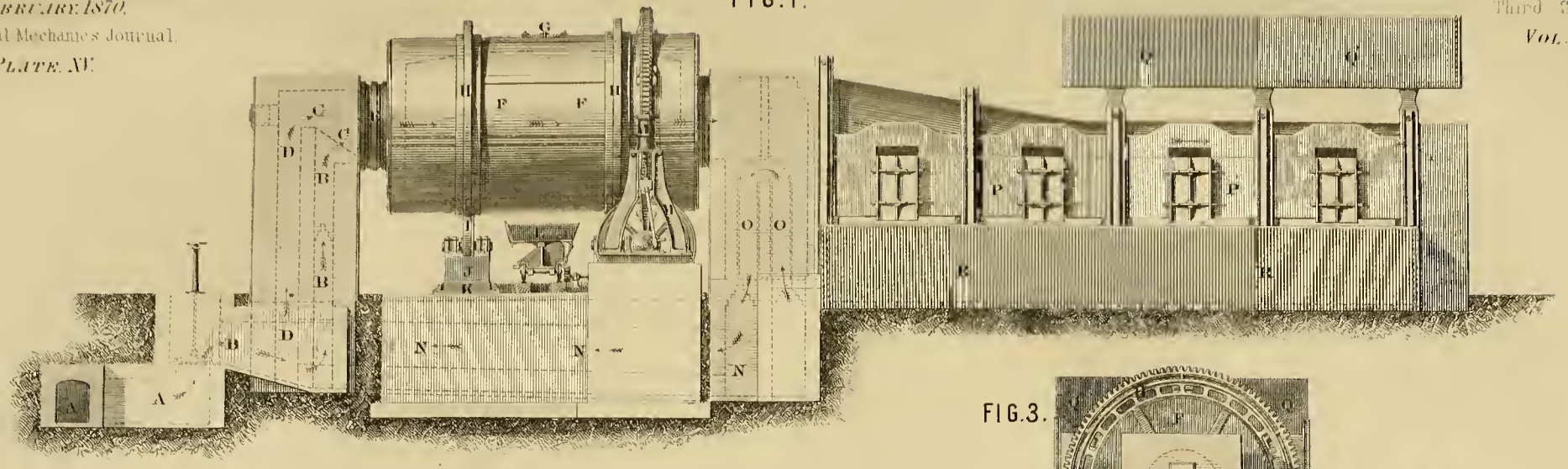


FIG. 1.




# BLACK ASH FURNACE,

R. DALGLISH & Co., ST. HELENS,

ENGINEERS.

FIG. 3.

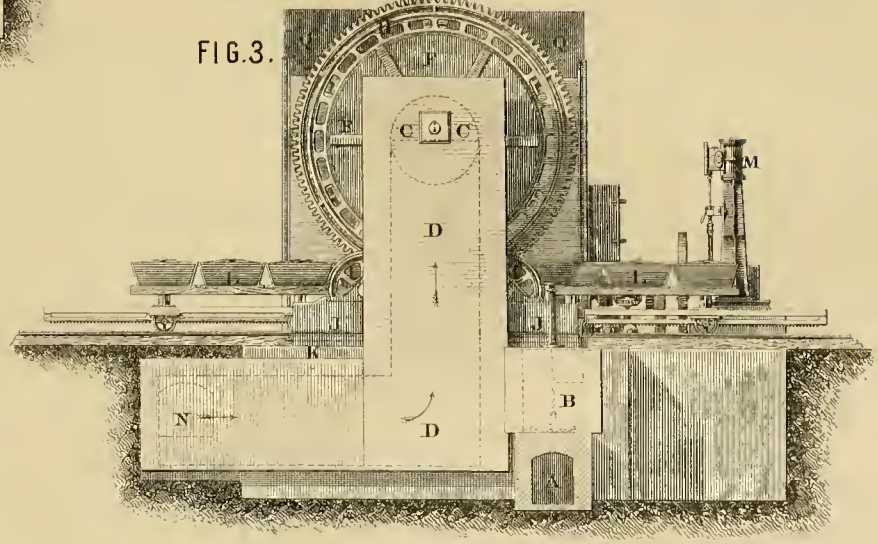
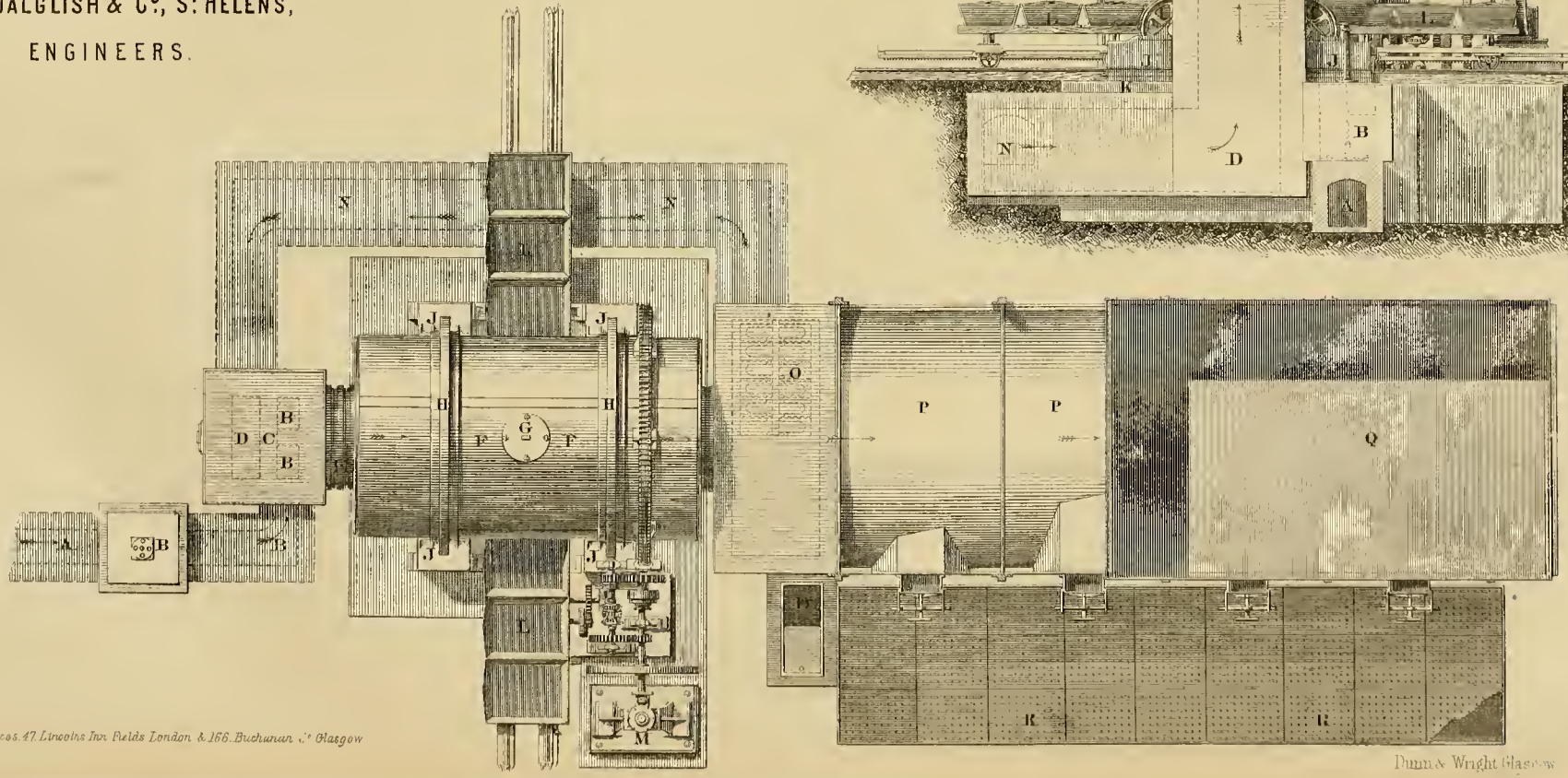



FIG. 2.




Patent Offices, 47, Lincoln's Inn Fields London, & 166, Buchanan St Glasgow

Dunn & Wright Glasgow

## OXYGEN GAS AS A NEW MANUFACTURE.—ITS USES FOR HEAT AND ILLUMINATION.

(*Continued from page* 204.)

But the industry of oxygen is not only interesting with respect to the development of heat under high pressure, but also with respect to the production of light. Every solid substance, indeed all substances, transform heat into light after a certain degree of temperature has been attained. The transformation is the greater the less fusible and less oxidable the solid substance is which is heated. The oxy-hydrogen flame, produced by the combustion of two volumes of hydrogen with one volume of oxygen, is little luminous, because it does not contain any solid element capable of transforming part of its heat into light; the flame of coal-gas is, on the contrary, highly luminous, because it contains carbon in a state which, being heated, becomes self-luminous at a high temperature—that is, *irradiating*. This flame becomes very bright if oxygen is introduced into the interior, but light diminishes again when a certain limit is passed. The irradiation of the carbon increases with the temperature ; the jet of oxygen in the flame of a gas-burner increases its lighting power, and more and more as the temperature of full combustion of the carbon is approached; but if that be passed, the luminosity again diminishes. We may here just remark that these accepted views as to the theoretical causes of more or less luminosity in flames being due wholly to solid (or liquid) matter exposed to heat have received a serious shock from the recent experiments of Dr. Frankland, who has found that luminosity is increased in flames free from such solid matter by mere increase of the pressure under which the gases are consumed. The subject is still obscure in many respects; but with a substance which resists very high temperatures, and for which the law of irradiation, as stated, remains true, it will be possible to educe a mode of illumination of a powerful intensity. Two different modes of application then, for the oxygen as a light of powerful luminosity, are derived from those fundamental notions, viz. :—

1. To bring the molecules of carbon of the illuminating gas to the maximum of irradiation, by raising their temperature by burning with the intervention of a current of oxygen gas :
2. To utilise the power of irradiation of a refractory substance (infusible and non-volatile at the highest temperature) submitted to the oxy-hydrogen gas in combustion.

M. Archereau is the eager promoter of the first method. He preserves untouched the actual system of lighting with gas, and merely injects into the flame of each burner a current of oxygen, regulated in such a manner as to bring the molecules of carbon to the maximum of irradiation. Experiment has proved that coal-gas which requires 16 litres to afford the light of one standard candle per hour, used in the ordinary way will, if oxygen be introduced into the flame, require but 2 litres of the same coal gas and 1 litre of oxygen to give the same light for the same time : thus a saving of between 40 and 50 per cent. is realised on the actual mode of lighting by gas. It will be in the recollection of some of our readers that this method of oxy-coal-gas burning was tried in London, about eight or nine years ago, under the auspices of Mr. Thomas Page, C.E., upon Westminster Bridge, but was not found to answer in point of cost. That was not to be wondered at, for cheap oxygen was then unknown. There was probably, also, a good deal of prejudice at work, and horses were said to have been startled by the glare of the light, the intensity of which was surprising. Its want of success tells for nothing against M. Archereau's existing proceedings.

This mode of lighting with coal-gas and oxygen is interesting with respect to public health. The combustion of a common gas-burner produces in the atmosphere an alteration of the same order as that determined by the respiration of a human being. The oxygen is absorbed, and its place is taken by carbonic acid, in addition to which we have here sulphuric acid and ammoniacal compounds. The introduction of the oxygen into the interior of the flame does not alter the exterior ; all is done within the flame ; the oxygen is destructive to all the deleterious products except the carbonic acid, which, with water vapour, alone are released. Considering the small volume of carbureted hydrogen gas burnt per hour, it will be found that the atmosphere is not only less vitiated, but also less heated by illumination on this method ; facts well deserving of being taken into consideration.

Notwithstanding the efforts of the inventor to popularise this method, it has not yet been submitted to what he views as a practical trial. The necessary laying down of lines of small mains in the streets, for the conveyance of the oxygen, has proved the principal obstacle. Paris, London, and all our great European towns are already so much undermined, that more pipes are a real difficulty; and it may be perhaps not without some show of reason that it has been said that there is some danger in these two gases coming together, side by side, in ill-jointed pipes beneath our pavements. The method becomes more practicable when the oxygen has to be supplied to the burners of theatres or public halls, &c.; the tubing for the oxygen can then easily be isolated : the gas is stored up, under pressure, in a gas-holder, in which it is directly brought from the works.

The light emanating from the molecules of carbon thus brought to the point of maximum irradiation, is very agreeable to the eye shaded from the flame ; it is itself of a light yellowish-white colour, which submits to diffusion, and which does not alter the daylight colours of dyed fabrics. It is a mode of lighting which may be thoroughly adapted to that mode of lighting which is called in France "the illuminated ceiling," such as is seen at the theatres du Châtelet and Lyrique, in Paris. It is equally adaptable for the footlights, which, however, would have to be provided with ground glasses to protect the eyes of the actors. Some great advantages have also been pointed out in the power of locally distributing the light at will over the scene, where novel effects could be very easily and strikingly regulated.

The other process of lighting, promoted by MM. Tessie du Motay and Maréchal, and which has been tried last and this year at the Place de l'Hôtel de Ville, and at the Tuileries, in Paris, is the resumption in principle of the ancient so-called "*Drummond light*," and which consists in *irradiating* a ball of quicklime under the influence of the combined flame of oxygen and hydrogen. The Drummond light has had many sudden changes of fortune ; at its origin it blew up the front of the Passage des Panoramas, in Paris, and a lighthouse in England, and for that reason was entirely abandoned in practice for many years.

We must pause here for a moment's digression, to remark that the late Mr. Under-Secretary Drummond, an able and ingenious man, but whose position alone probably enabled him unchallenged to indissolubly connect his own name with the limelight, had in reality little or no claim as an original discoverer or inventor to any such connection. All that is essential to the production of the limelight had been long before him anticipated—slightly by Dr. Clarke, completely by Dr. Robinson, of Armagh, who, in a paper in the Transactions of the Royal Irish Academy, vol. 13, for 1818, on the combustion of oxygen and hydrogen gases, at p. 98 and subsequently, forcibly refers to the light disengaged from various solids exposed to the oxy-hydrogen flame. "The intensity of this (the light) is astonishing. . . . The glare of some bodies, as lime and magnesia, is intolerable, even when the eye is defended by dark-green glasses" (p. 98). Dr. Robinson then proceeds to discuss the physical theory of this intense light, and in the same page equally anticipates nearly all that has been since suggested on this, as yet, incompletely understood subject. Drummond's real claim is, we believe, limited to that of being the first to propose the application of the limelight to geodetic operations, and having carried out with success his proposal.

Many improvements have been adapted to the limelight apparatus, which are very simple, the main point being to isolate the two gases in their conveyance, for, inoffensive when separated, they risk destruction to everything whenever they are united. The service of the theatres, as yet one of the principal applications of this source of light, failed to be fully successful through guilty ignorance, which in its early career caused some deplorable accidents. But to return : the projectors of this system do not employ lime as the irradiated substance, but magnesia, prepared in a special manner, as indicated by M. Caron.

Considerable masses of magnesia in the form of carbonate are found in the Island of Eubéa containing traces of lime, silica, oxide

of iron, and veins of serpentine mixed with large flakes of silex. The mass is calcined in order to disintegrate it, and the serpentine and flint, which do not break up, are picked out. The magnesia, after calcination, in order to prevent the contraction which would otherwise appear after baking in the moulds, is made into a paste with water to which 10 or 15 per cent. boracic acid has been added, and it is then shaped in iron moulds with strong compression. The material is white, compact, and hard, when thus divided into cylinders of 6 or 7 millimétres diameter by about 30 millimétres in length. Such a cylinder is the source of light when subjected to the oxy-hydrogen flame. The cylinder of magnesia is held in such a manner that it may receive the jets of the mixed gases oxygen and hydregen, emanating from three convergent burnors, so arranged as to heat the cylinder in a uniform manner. The column of magnesia becomes soon irradiated, and then appears as a bright point, whence emanates a blindingly white and dazzling light.

This was tried first in public in Paris, at the Place de l'Hôtel de Ville, where 40 burners of this sort were worked comparatively every evening against 40 ordinary gas burners, each system lighting one side of the square: the effects were extremely striking—the gas flames appeared to be mere smoky red dots. One burner of this magnesia light is equal in intensity to 25 or 30 burners of the best commercial coal-gas; so that it is contended one new burner (magnesia) may be substituted for twenty of the old ones (coal-gas) in future lighting. The first question which occurs is this: Will the same extent of surface receive the same quantity of light from this one, instead of from twenty burners? An optical law tells us that the same total of light illuminates much more and better when diffused from several different centres than when concentrated into and radiated from a single point; and the experiments which were made for lighting the Place du Carrousel and the Palais Royal at Paris with the electric light elevated in the centres of these squares, have well proved the uselessness of such a mode of illumination. In the present case, when the experiment was made with an equal number of oxy-hydrogen=magnesia, and of coal-gas common burners similarly hoisted, a very characteristic difference ought to be expected. And yet, if the difference of illumination thrown over equal surfaces at equal distances by the two systems at the same time be observed, it is surprising in what confusion as to principles we find ourselves by the result. On one side, brilliant points like stars, upon which the eye cannot rest, but which keep the power of their beams in a state of concentration, as judged by vision only. On the other side, dull yellow flames which yet disperse the light. The colour of the flame must equally be taken into consideration; and of all the usual flames, the tint of that of the coal-gas is the more agreeable to the eye; it gives the best distinctness to general objects, and is most favourable to diffusion. The increase of the power of irradiation of the carbon of coal-gas, intensified by the calorific influence of oxygen admitted to the flame, as we have described, does not alter that tint, it is stated, but only intensifies it. Thus this circumstance proves in favour of the first-described project. It is also to be remarked that it is of great importance, in order to give the maximum of light with the magnesia system, that the velocity of efflux of the two gases be strictly regulated. The smallest variation in either is a cause of reduced temperature, the slightest amount of which produces a very sensible diminution in the intensity of the emitted light. If, also, the cylinder of magnesia is badly made or badly centred, it will not any longer furnish its share of light. It will be evident, in fact, that such a mode of town illumination must require a very active, constant, and very skilful inspection, and yet be liable to frequent accidents.

With respect to cost, the inventors state it to be 50 per cent. below that of the actual gas-lighting. The estimates leave room for doubt as to the cost of the cylinders of magnesia, however, and M. Caron acknowledges that magnesia, although it wears away less than the lime, nevertheless does wear away considerably, in consequence of an actual carrying away of matter by the mixed gas-flame; and thus the intensity of the light which has to be paid for varies in proportion. How long each cylinder will last, must thus be taken into consideration. M. Caron assures us, however, as the result of his most recent researches, that he has found the true refractory substance which gives the final solution of this question. This new substance is the earth or oxide zirconia. M. Caron moulds this oxide of zirconium under powerful pressure, and has attributed to it, in addition to greater durability in the flame, a much higher power of irradiation than is possessed by magnesia, which he proposes definitively to abandon. Experience has not yet proved that zirconia is itself absolutely fixed; but its illuminating power is intense. It is, however, more than doubtful whether illumination by the irradiation of refractory matters is practically and advantageously applicable to the illumination of towns. It may prove of occasional value, as for projection in theatres, and for some other and graver objects; but the oxy-hydrogen light with the lime, the magnesia, or other refractory substances, will suffer the same discredit as the electric light if its right uses are spoiled by misapplications. The essential question, which affects its future as well as that of its rival system, the economical production of oxygen, has been solved; it is of equal importance now to find a body of strong irradiating power endowed with a long duration and perfect steadiness and simplicity of action. Whenever this double question shall be solved, the application of the electric light as a means of illumination in theatres, and in all those cases where it may be impracticable or too expensive to produce it by means of magneto-electric machines, wrought by power, will be abandoned.

All depends upon cheap oxygen, the production of which at a low price is not unimportant also in relation to public health. Oxygen has been administered for several years past in cases of chest disease, and this treatment is viewed abroad as likely not to be dispensed with. If it be really efficacious, it would be obviously important to supply the element of life at the cheapest possible rate. Might it not be advantageous to ventilate the wards of hospitals and barracks &c. with air more than naturally rich in oxygen? But that question belongs to the applications of the extraordinary oxygen called *ozone*, rather than to that of the element in its ordinary state, in which it is applicable to illumination. Further experiments, with public aid, are stated to be still in progress in Paris, with a view to rendering—notwithstanding the difficulties which, in everybody's hands, still beset the subject—the magnesia, or lime, or zirconia light materially cheap, steady, and manageable.

The supply of zirconia (a rare mineral body) seemed at one period a difficulty, but that is stated to have been removed by the discovery of abundance of crystallised zircons, even in France; and from Ceylon, and probably from Australia and California, these may be had without limit. The difficulty as regards the light itself seems at length to be resolved simply into one of keeping the pencil of the moulded and compressed earth from being carried off in minute particles by the gas currents and flame. But assume the whole effectually accomplished; we confess we entertain great doubts that this method of illumination can ever prove good for cities or public places. The question is really not one of physical optics, or of mere amount of light delivered at a given point, at a given cost. It is rather a physiological one. The illuminating points *must* be exposed more or less directly to the eye. Just in proportion, then, as they are intense in light emission, have they a perfectly blinding effect upon the eyes of those obliged to encounter their direct rays, which prevents for the moment vision in all other directions. This is just the most fatal of all possible evils in any system of street illumination, for a man may be run over just at the very instant at which his vision for all objects around and near him is destroyed by his eye encountering the glare of a distant point of intense light.

If, indeed, M. Caron, or those who act with him, can devise any method, whether by peculiar position or by opaque or only more or less translucent partial shading of these zirconia lights, whereby they shall diffuse their splendid beams in the necessary directions, and yet that the focus of light itself shall be hidden from all eyes, or from all under the condition common to passengers in the streets, then, and then only, do we think that their method may become publicly available, and that the unquestionable advantages of brightness, greater than any as yet common, may be secured to our streets at a cost as small, if not smaller, than that of the existing gas illumination, which, great and important as it is, yet leaves so much still to be desired.—Ed.

## SOME GERMAN SYSTEMS, AND TRUE AND FALSE SYSTEMS OF IRON PERMANENT WAY.

It has been often said, and with some grain of truth, that in engineering matters the record of a failure is often practically more valuable than that of a success. It is quite as true that there are projects and designs which it is well to notice, as saliently, things to be shunned. It is in this sense, and in this only, that we devote a little space to certain German projects of so-called permanent way, the earlier notices of which were given in this country by Mr. T. A. Rochussen, and whose parts were exhibited at Paris in 1867. These ways have been to a limited extent laid down upon certain German lines, and very flourishing accounts of their admirable working were for some time given. We lately hear no more about them; and our own observation during last year only confirmed the judgment we formed on *à priori* principles of these several sorts of iron way when first we saw them in Paris, and as figured and described in German professional journals.

These systems have all the following traits in common. The rail is itself, or by help of built-up fish pieces, of enormous depth, and, therefore, of enormous rigidity and great weight, directly upon the ballast; the gauge and cant depend merely on cross ties, and the base of the rail is buried to such a depth in the ballast as to be got at or packed with much labour and difficulty.

The earliest of these deep keel rails (of German extraction, at least,) was laid down upon the Coblentz and Oberlahnstein branch of the Rhenish Railway, near Enskirchen, from a design by Herr Hartwich, C.E., engineer of the line. It is shown in fig. 1. These tall thin rails were no less than eleven inches in depth, and weighing 115 lbs. per yard, with a base of only four inches wide. These were laid directly on the ballast, and immersed in that or "boxing" up to the big top flange. They were fished and cross-tied. They seem to have proved, as might have been anticipated, too heavy, and yet rickety, and the next form appears to have been that of the lighter rails of figs. 2 and 3, of nine inches in height, the fishing of the joints being shown in fig. 2, and the cross ties at intermediate points in fig. 3. Several miles of this were laid upon the line between Kaltenkirchen and Kempen; it weighed between 140 and 150 tons per mile of single way. It is very difficult to get at a trustworthy account of what has been here "the proof of the pudding." We can, however, testify to the unmistakeable hardness felt in travelling over it.

Fig. 1.

Fig. 2.

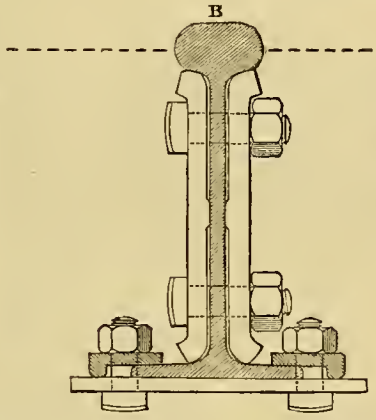
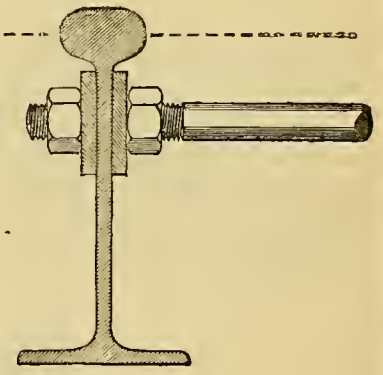



Fig 3.



Upon the Brunswick line, about five years since, the modification of this sort of way, shown in figs. 4 and 5 (4 being a cross, and section 5 a part longitudinal elevation and section of the cross tie), was rolled at the Hörder Works, in Westphalia, and laid for about three-quarters of a mile in length; the bulb-topped rail being understood to be of steel. Certain difficulties stated to have been experienced in the rolling or fitting of the under angles and flange or keel of these rails, caused the substitution, at the suggestion of the manufacturers, of the form, and mode of securing together the rail top and its continuous fish plates, shown in fig. 6, in which the new form of cross tie is also seen.

Fig. 4.

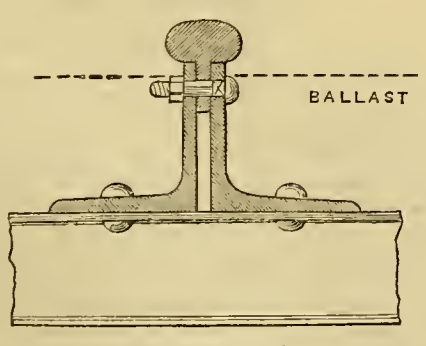
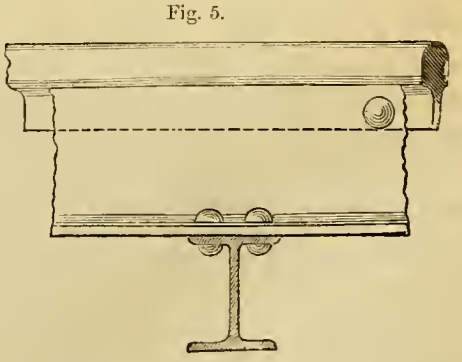



Fig. 5.



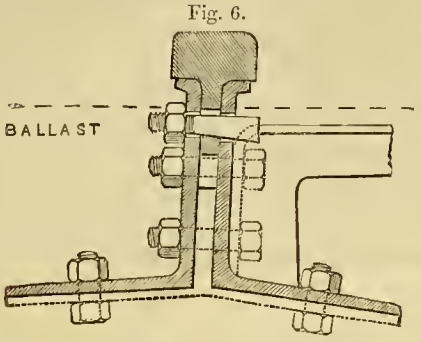
The weights of these systems were respectively—No. 2, 354 lbs. per yard, and No. 4, 300 lbs., but of the accuracy of the last weight we entertain some doubts. Very flourishing accounts were given by the reports of Herr Scheffler, C.E., the engineer of the line, of the excellent success of these, about two and a half years back, and it was at that time confidently stated that this success had induced several other German lines, notably the Cologne and Minden, the Saxon and Wirtemberg, and the Hanoverian, to lay down experimental lengths. Last autumn, however, our own enquiries failed to discover where these experimental pieces had been laid, if at all, and, in fact, it seemed as if all these once hopeful projects of deep and rigid rails had quickly dropped asleep—perhaps a quite sufficient indication of their real value.

Fig. 7 shows the modification of this system adopted on the Hanoverian line, and in most respects seems to us the worst form of them all, especially in the hollow base, which must prove almost impossible to lay or pack solidly beneath, and whose multitudinous bolts and nuts, notwithstanding their being "out of sight and out of mind" deep in the ballast, are pretty certain to shake loose and become dangerous. This form must have been still heavier also than any of the others. Indeed, a modification of it, as proposed by M. Rochussen in 1867, weighed no less than 223 tons per mile of single way, and the estimate of cost was no less than £3,123 per mile, at the price of iron in Prussia at that date. As regards originality, all these systems are in one way or another anticipated by the various early systems of way of our countryman Mr. Bridges Adams. We apprehend he now, in common with every railway engineer, in the British Islands at least, sees fully the necessity, if iron way without timber base is ever to become a success, of contriving, not the heaviest and most rigid and inert a system possible, but the lightest possible consistent with strength to carry the rolling load, and one which shall possess at least as much elasticity as if timber laid—or perhaps even more—but which elasticity shall be perfectly adjustable and within control.

The German engineers who have advocated or adopted these rigid and heavy systems—contrary to the scientific habits of thought of their professional countrymen—seem never to have realised the results of great inertia and great rigidity of way combined, both on the material of the way and upon the rolling stock

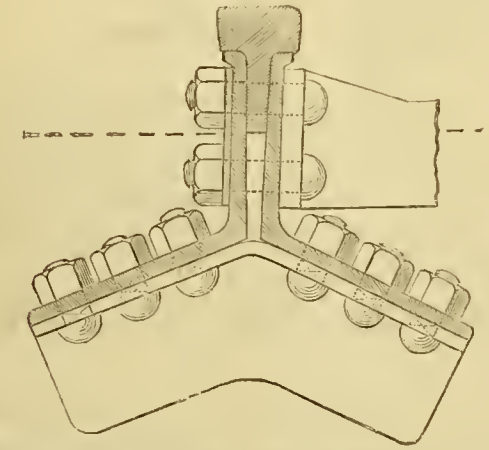
that passes over it. Even some of the oak cross-sleeper lines with flat-footed way in Westphalia and in France show a clear want of realisation of this. It may be a fact that upon such a line the train mile expenditure, for mere traction, is for a time rather less than on timber-sleepered way, or other more or less yielding ways, but this is to keep out of view all the other and more important parts of the question. Rigidity and inertia inevitably mean *blows*, between rail-top and wheel, for everything that rolls over at any high speed. The rail-top may be of, crucible steel (if you like) or of any other material—and the life of a steel rail laid on timber may be twenty years or upwards; but if its life be as great here, the task of its life will, and must be, to hammer to pieces the less hard iron to

Fig. 6.




which it is fastened, and by whose thin upper edges it is supported, and equally to hammer and destroy the wheel tyres, axles and axle bearings &c. by which the rigid top-rail is itself hammered as they roll upon it. Perhaps no plan of an elastic iron way has yet been produced destined at once to supplant all other iron ways; though one, if not more patents have been taken out within a year or two for such ways, that appear well deserving of a careful and impartial trial. Amongst these, that patented by Mr. R. Mallet, C.E., is so characterised by the sound principles upon which it has been designed, that we do not hesitate to say it occupies a prominent place for such trial.

Fig. 7.



But railway engineers ought ever to hold in view two facts: no heavy and rigid iron way can in the long run ever be a cheap one, no matter how apparently small may be its outlay cost; no really good, that is, light, strong, and elastic iron way ever can for its outlay cost be a cheap one; but if it truly fulfil the conditions of its design (as above) it will in the end, say in an epoch of ten years' work, be cheaper than any line which even at far smaller first cost does not meet these essentialities, of *minimum inertia, ample strength in the required directions, and assured and adjustable elasticity.* It is because these German systems which we have described do not possess any one of these essentials that we place them in the *index vitandorum* of railway engineering.

## BLACK ASH FURNACES, &c.

*(Illustrated by Plate XV.)*

One of our plates this month (in which fig. 1 is a side elevation, fig 2 a plan, and fig. 3 an end elevation of the apparatus) illustrates fully the construction of the new revolving black ash furnace now at work at the British Alkali Works, Widnes, near Warrington, Lancashire, where it has been constructed by Messrs. Robert Daglish & Co., engineers of St. Helens, the furnace being on Siemens' regenerative principle, and arranged by the inventor of that system. A similar furnace is also at work at Messrs. Alhusen's great alkali works near Newcastle, where we inspected its operation personally a few months ago. The furnace there, however, does not work upon the regenerative plan.

Until a comparatively recent period the original soda process of Leblanc has been followed in Great Britain almost exactly in the way planned by that able French technical chemist.

The only exceptions have been that, in place of lime and charcoal powder, chalk, or limestone and small coal have been employed, for cheapness, to decompose the sulphate of soda produced by the action of sulphuric acid on common salt. It seems probable that Leblanc intended, if he (or those who soon succeeded him) did not employ, calcining pots or crucibles; but the reverberatory furnace was very soon substituted, and it has continued in use to the present hour, though it is not improbable that it may be soon and largely supplanted by this revolving and self-acting furnace.

The usual black ash furnace is, in fact, not much more than a big reverberatory, like an iron puddling furnace, and the salt-cake while exposed to its action in one part of the furnace, which consists of two or three compartments, is "rabbled" or worked by the workman with a long iron rake in much the same way. The labour is quite as severe, if not more so, than that of the puddler; for though the temperature and radiated heat to which he is exposed are less, his rake is longer and its resisting leverage against his muscles longer also; and though the density of the black ash be less than that of the iron "ball," the mass worked is much larger, and the man's work is almost unintermitted.

Hence the substitution of a mechanical furnace for this crude and savage form of labour will be a real boon to the worker.

It will also prove a great one ultimately to the manufacturer, if it should prove fully sustainable that within a given factory space a much greater quantity of soda ash can be worked off per day by this furnace than by the old ones, covering equal ground, and that the charge in such case is more quickly worked through the furnace. A certain deficiency has been always recognised as occurring in the old reverberatories between the amount of soda in the sulphate submitted to its action and that in the produce, without taking account of any absorbed by injurious reaction of the alkaline salts on the walls of the furnace, which is not great at the temperature required.

This has been, and no doubt rightly, attributed to metallic sodium and sulphuret of sodium in concert flying off in a volatile state and getting condensed in the flues, or flying away and being slowly oxidised in the atmosphere. Now it is obvious that the more tedious the reaction in the furnace, whatever be its nature, the more of this loss by volatilisation must occur.

This, in part at least, the new furnace proposes to economise.

The following is a sketch of its construction and of the process generally to which it is contributory:—

The cylinder or furnace which we illustrate is 9 ft. in diameter and is 16 ft. in length, made of boiler plate, and lined inside with fire-brick; it is supported on friction rollers, as shown, and is driven with gearing worked by an 8-horse power engine. The revolution of the furnace is regulated to suit the manufacture of the black ash, and varies from one revolution per minute to one in twenty minutes. The proportion of the salt cake and carbonate of lime is placed in the cylinder through a hole in the top, as in the usual revolving boiler used in paper mills, which hole again becomes the means of discharging the black ash into the wagons when the process is complete. *A* shows the valve by which the gas is admitted, B, B the inlet and supply valve, C, C the combustion chamber, D, D the air inlet, to which is fixed the expansion ring of

the cylinder, which ring is marked E; then comes the black ash furnace or cylinder F, F, with the letters G, G marking the trap-door by which the charge enters, and departs into wagons placed beneath, and which are marked L, L. The cylinder revolves on friction rollers I, I; and H, H indicate the friction rings; the foundatiou bearers J, J sit upon strong iron tie plates, the latter marked K, K; M, M are to indicate the position of the high-pressure engine used for driving the cylinder and working the wagons in which the black ash is removed; N, N the air flue by which the heated air is supplied to the combustion chamber, and which is heated by the waste heated air that has been driven from the furnace; O, O is the heater, which is of cast iron of the shape shown; P, P is the salting-down pan, over which the waste heat from the revolving furnace passes; Q, Q is the reservoir from which the salting-down pan is supplied, and the drainer pan is shown by the letters R, R. After the gas has done its work on the "charge," and the contents of the cylinder have become of a doughy consistence, chemical decomposition begins and the mass boils—or appears to boil—and when the carbonic oxide and the sulphuretted hydrogen have passed off black ash is completed aud is cast into wagons, in which it becomes solid; it consists of a mixture of undecomposed black ash, with ball soda, or "British Barilla," consisting of caustic soda and carbonate of soda.

The chemical changes which take place in the foregoing operation are somewhat complex. The sulphate of soda, by calcination in presence of carbon, loses its oxygen, and becomes converted into sulphuret of sodium; the carbonate of lime aud the sulphuret of sodium then act upon each other, the oxygen of the lime converting the sodium into soda, and the carbonic acid of the lime uniting therewith to form carbonate of soda, while the sulphur of the sodium unites with the calcium of the lime to form sulphuret of calcium. This last-named substance, called soda waste, is a source of great annoyance to the manufacturer; it is bulky, and is applicable to no useful purpose yet known. Attempts have been made to remove the sulphur from it, but the cost always, until recently, under the treatment adopted at Dieutz on the Continent, exceeded the value of the sulphur obtained; therefore it is waste in the true sense, as manufacturers are often obliged to have a piece of land whereon to deposit the stuff, and for that purpose alone. The next process is to separate the soluble matters from the black ash. A ball of, say, 3 cwt., as it leaves the black ash furnace, affords an average of $1\frac{3}{4}$ cwt. of soda ash. The insoluble ingredients consist of carbonaceous matters, carbonate of lime, and a compound of lime and sulphuret of calcium. The soluble ingredients are carbonate of soda, a little undecomposed sulphate of soda and common salt, some caustic soda, and some other ingredients. The separation of these matters is the first step towards the preparation of pure soda from black ash, and this is effected by reducing the mass to fragments, either by crushing or exposure to the vapour of water, the latter causing it to swell and then crumble to pieces. The fragments are then placed in vats, with warm water, and in ten or twelve hours the soluble matter in solution is drawn off and the residue washed six or eight times successively, either with fresh water or with more dilute solution, the washing of other vats. The lye thus obtained is evaporated to dryness in leaden pans, or first in an iron vessel, by which carbonate of soda is obtained, mixed with a little caustic soda and sulphuret of sodium. This is further purified by mixing it with about one-quarter of its weight of sawdust in a furnace. When the sulphuret of sodium parts with its sulphur, it becomes converted into carbonate of soda. In the new plan of furnaces the sawdust is omitted, as the gas in the revolving furnace does the work effectually. When the liquid has assumed the consistence of mortar it is raked into a large iron vessel having a perforated false bottom, so as to allow the mother liquor after lixiviation to drain off from the crystals. The drained mass is then put into a finishing furnace and moderately calcined. The residue of this operation when ground under millstones is the white ash or soda ash of commerce, and is sufficiently pure for most of the manufacturing appliances of soda, but for the manufacture of plate glass, and for furnishing crystals of carbonate of soda, the ash is rendered still purer by a further calcination at a moderate heat. For the crystalline carbonate, the purified ash is dissolved to saturation in hot water, and the solution run into large hemispherical iron pans. The soda separates in very large well-formed crystals, which are again broken up and the mother liquor allowed to drain off. These crystals are carbonate of soda of commerce nearly pure; 100 parts contain 21·81 soda, 15·43 carbonic acid, and 62·76 water. The mother liquor which drains off contains nearly all the foreign salts, and is evaporated to dryness; it generally contains about 30 per cent. of alkali, and is used by the manufacturers of soap and of plate glass.

The operation of this form of furnace, when we witnessed its work, was apparently perfectly satisfactory, and, to the eye, the reaction was as complete as in the hand-wrought reverberatories, the temperature being uniform, sustained, and sufficient, and the mixture and continual agitation and mutual interchange of parts in the pasty, bubbling mass being complete. We may add that the operations of filling, emptying, and firing appeared to go on with ease and regularity.

Nothing, of course, but a train of exact analytical research, conducted comparatively, with this and with the old furnace, could, however, decide whether the final product of the one furnace be as perfect or more so than that of the other; and this is the paramount question in reality as regards this revolving furnace—Does it or does it not, ton for ton, yield as perfectly decomposed a product as does the old one?

The experience of the great alkali firm at Newcastle which we have named answers this decisively, and in the affirmative, and, for ourselves, we can see no reason whatever why that opinion should not be perfectly well grounded.

It is but right to state, however, that it is as yet not quite shared in by some other alkali makers in the Tyne district, and, notably, Mr. Lowthian Bell has publicly expressed his opinion, as based on observation, that, owing to less perfect mixture possibly, the final result is not as good as with the old furnace, which, in fact, would go part of the way towards a verdict of want of economy. This opinion, however, was uttered a good while since—in the infancy of the revolving furnace, before gas fuel and regenerative principles (we believe) had been applied to it; and, probably, Mr. Lowthian Bell would at present be prepared to modify his view.

This we may add, that every great train of operations in chemical manufacture involve necessarily so much of tentation—for a long time, and until experience shall have supplied all the vacant spots left by our imperfect theoretic knowledge of all that goes on at every moment in the course of complicated reactions—that *no* new apparatus, however good in principle, design, and practical adaptability, *can* be a full and complete success at once. When this time, and the experience it will bring here, shall have been afforded, we think there is a fair probability that the anticipation of Messrs. Daglish & Co., who have laid themselves out for the perfectionating and supply of these revolving furnaces, will be realised, and that they will supersede wholly the hand-wrought reverberatories.

The general idea of this revolving furnace, curiously enough, is very much that of the Patent Revolving Puddling Furnace of some years back, invented by Mr. Yates; so that, as the old alkali furnace resembled the old iron puddling furnace, so does the new one resemble the newer or revolving puddling furnace.

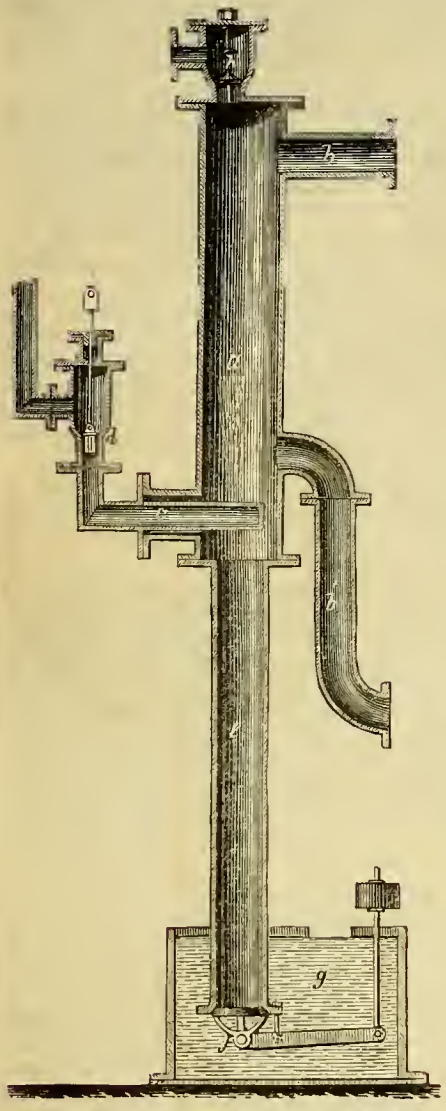
## A FURTHER NOTE ON "*BLOW-THROUGH**" AND "*EJECTOR*" CONDENSERS.

At pages 151 to 154 of the present volume we recorded various apparatus in which the residual energy of exhaust-steam is or has been used for expelling the injection-water from the condensers of steam-engines, thereby avoiding the use of air-pumps; but further investigation of our subject has revealed other apparatus, designed and effectively employed for the same purpose, and over which we cannot, without doing an injustice, pass; especially so, as in any future *complete* and *impartial* history of the steam-engine the arrange-

* We regret a numerical misprint in our former paper at page 153, lines 7 to 5 from the bottom, where it is said the "pressure falls from 32·5 lbs. at the beginning to 10·5 lbs. at the termination of the stroke." As 32·5 lbs. is an *absolute* pressure, including the atmosphere, 10·5 lbs. should read 25·5 lbs.; omitting the atmosphere the numbers would be 17·8 and 10 8 respectively.—V. D.

ments to which we now allude must in strict truth have their own proper place and importance allotted. The first of these to which we have to refer is the condenser, designed and made in 1824 by Mr. John Pattison, and fitted to a pumping-engine at the Elswick colliery, near Newcastle-on-Tyne. This condenser is illustrated in vertical section at fig. 1. It consists of a condensing-chamber *a*, into which the steam is educed from the cylinder by the passages *b* and $b^1$. The injection-water is admitted through the jet *c* at the proper interval by the lifting of the injection-valve *d*. In the Elswick example we are informed that the tank from which the water fell was 22 feet above the condenser. From the condensing-chamber *a* a passage *e* extends, provided with a foot-valve *f*, and immersed in the cistern (hot well) *g*. A snifting-valve *h* is placed at the top of the chamber *a* for the discharge of air, the valve being as light as possible, in order that it might be lifted by an extremely small accumulation of air. Mr. Pattison has himself described both the condenser and the engine to which it is applied, and we are indebted to Mr. T. Patterson of Maryport for having made the description public in the columns of a co-temporary a little over a year ago. We now quote it :—

Fig. 1.



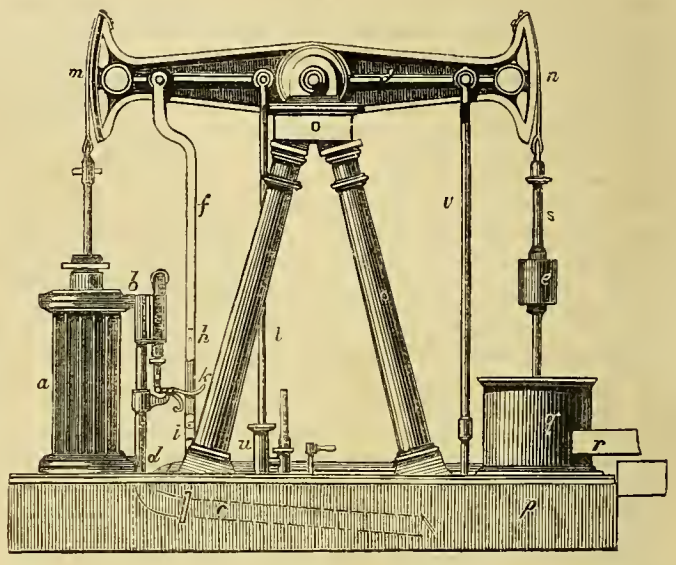

"The cylinder of this engine is 31½ inhces in diameter, and making seven 8-feet strokes per minute, discharging at each stroke 64 gallons of water from a depth of 55 fathoms. Previous to the construction of the condenser, the boiler was loaded to 34·7 lbs. per square inch, and consuming 69 cwt. of coals in 8½ hours.

"After I had constructed and applied the condenser, and attached a pump from the hot well to feed the boilers (the engine going at the same rate, and performing the same quantity of work in the same time), the pressure of the boiler was reduced to 27 lbs. per inch, and consumption to only 41½ cwt. of coals.

"Nothing could be more satisfactory than this result; and to prove the nature and extent of the vacuum, I attached a mercurial barometer to the condenser, and found it sustained a column of mercury of an average height of 14 inches, its greatest altitude being 22 inches.

"This condenser requires blowing through previous to starting; but in order to produce here the maximum effect, the injection must be so regulated as not to cool the condenser below the temperature at which the snifting-valve will be opened once every double stroke.

Fig. 3.



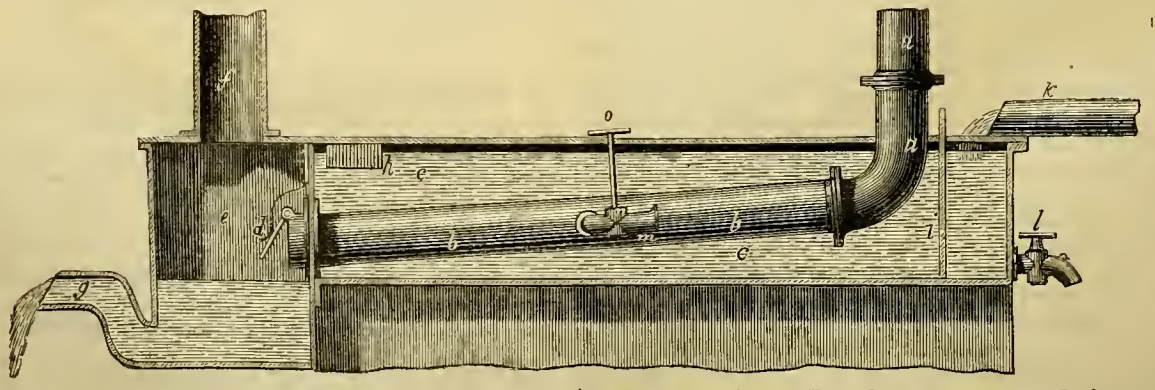

"The upper discharging-valve is opened into the condenser a little before the injection, which, of course, lifts the snifling-valve, expelling the air previously contained. At the same instant the injection is thrown in, when a vacuum is produced of about 22 inches of mercury. It will be seen that the injection-water, together with the condensed steam, pass down the sink-pipe, and are discharged at the foot-valve at the same time the air is expelled.

"This valve is kept in its seat by a weight and lever which is nearly equipoised, and which readily admits the discharge of the water into the hot well.

"From what I have stated it may be objected by some, that the vacuum is not constant.

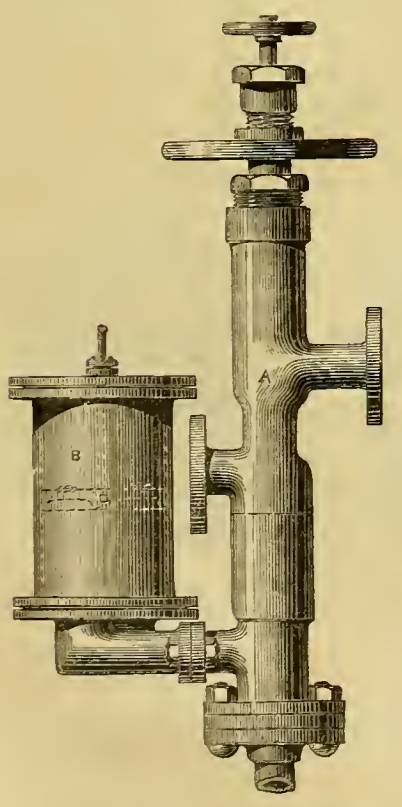
"This, indeed, must necessarily be the case, from the manner in which the air is expelled; but as far as regards its action on the engine it is not productive of the least irregularity, but on the contrary of a real and permanent increase of power."

Fig. 2.



Another arrangement of "blow-through" condenser is that invented by Dr. Ernst Alban of Plau, Mecklenburg. It is published, with full working detail drawings, in Alban's work on the steam-engine, *Die Hochdruck-dampfmaschinen*, of which an English translation was made some years ago by Professor Pole, and published in 1848. Indeed, this is a work which deserves to be far better known, and we can with confidence say that if it were republished with the various articles revised in accordance with the latest practice, there would be room for it in engineers' libraries; for this author touches on some points of real importance almost wholly neglected by our British authors on the steam-engine. His condenser is shown at fig. 2, where *a* is the eduction pipe of the engine, *b* the condenser, a pipe of sheet copper, the same diameter as the eduction pipe, and about twice the length of the stroke of the engine. It lies in a cistern *c*, supplied with water from a pipe *k*; *i* is a sieve to prevent any particles of dirt getting into the part of the cistern from which the injection water is drawn, and *h* is an overflow by which the waste runs off; *l* is an emptying-cock. The condenser is laid on an incline; the lower end projects out of the cistern into a box *e*, and is furnished with a hanging or flap-valve *d*, opening outwards; *m* is a small pipe in which is fixed the injection-cock *n*, turned by the key *o*. The pipe is bent in the interior of the condenser and has a mouth-piece *b*, so shaped as to spread the jet of water.

Fig. 4.

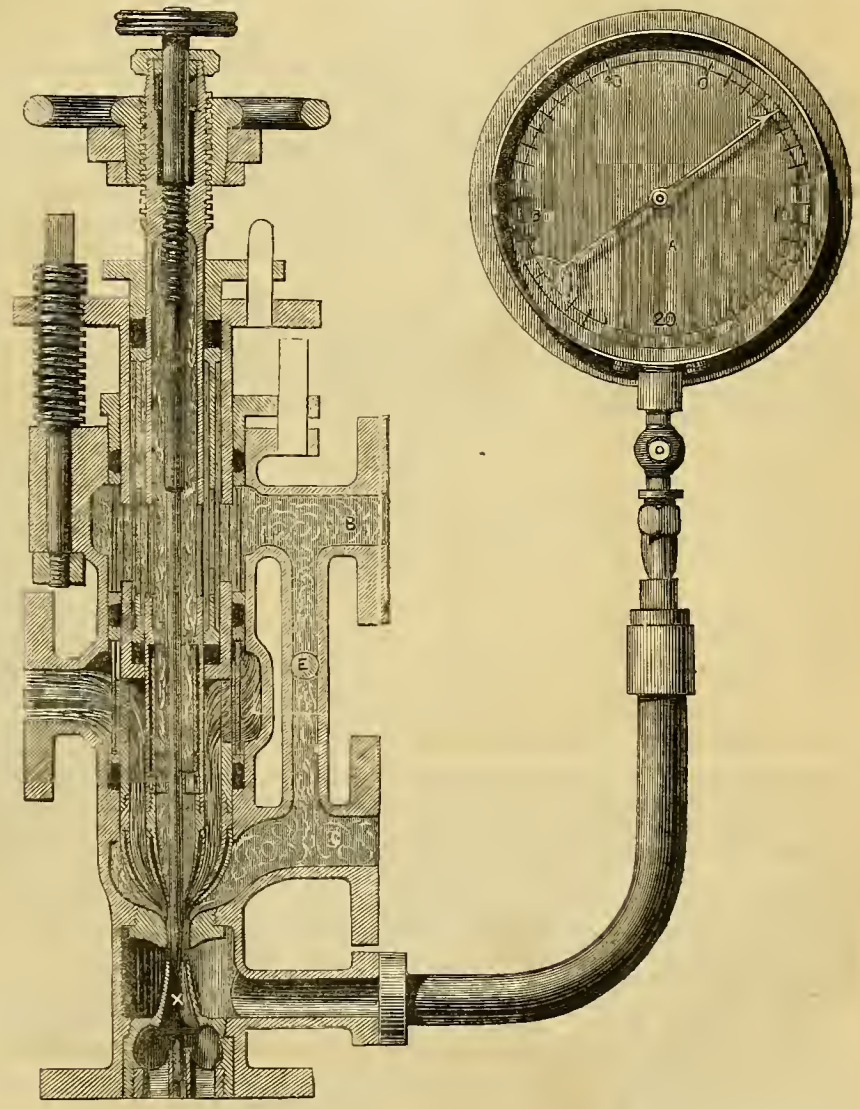



The action of the condenser is described by Dr. Alban as follows:—"At the moment the eduction passage is opened to the cylinder, the steam, having a pressure considerably above that of the atmosphere, rushes through the pipes, stops the injection, and blows the water and air collected in the condenser out at the valve *d* into the vessel *e*. This, however, is but the work of a moment: the valve immediately falls, the jet of water again enters, and the steam is condensed. The air and vapour pass away from the vessel *e* by the pipe *f*, the water by the pipe *g*.

"I have only yet had opportunity of applying this condenser to two engines—both being single-acting and used for pumping water. No barometer can be used with it, for obvious reasons, and therefore it is difficult to tell exactly the state of the vacuum. The best proof, however, of the efficiency of the apparatus is that the engines, even when they are in their most powerful and quickest action, will be stopped by simply closing the injection-cock."

At fig. 3 is shown an engine of Dr. Alban's construction, with one of these condensers, and of which we quote the following particulars:—It was an "engine of two horse-power, erected by me for the purpose of clearing a turf moor at Dobberan, and in which the steam is cut off at one-half the stroke, lifts thirty to thirty-six million pounds of water a foot high by the consumption of an English bushel of coal*—a very high result for so small an engine." The author further says, "In this I have used a beam, though it is by no means absolutely necessary. The cylinder *a* is constructed for single-action, i.e. working by the descent of the piston only. The valve *b* is a slide, and *g* is the beam, having upon the ends two arcs *m* and *n*, to which the piston and pump-rods are hung by strong straps (*Riemen*); and as the engine is but of the small power of two or three horses, these answer very well; *o* is the framing; *p* the pump, which is of copper, furnished with a cistern *q*, and run-off trough *r*; *s* is the pump-rod, and *e* the counter-weight; *c* is the condenser, and *u* the feed-pump, with its rod *t*; *v* is a catch-rod, to prevent the engine making too long a stroke either upwards or downwards.

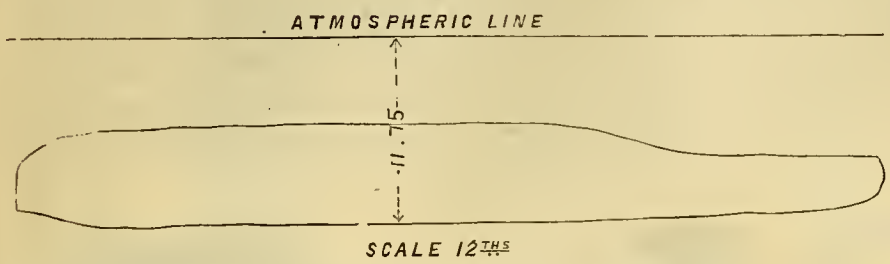
Fig. 5.




* Equal to 5 or 6 lbs. per horse-power per horse.

"The lower end of the cylinder is constantly open to the condenser, by a side-pipe *d*. The steam acts upon the upper side of the piston, and is cut off at half its stroke by the valve. At the end of the stroke the steam blows into the condenser, and a vacuum is soon formed above as well as below the piston; the counter-weight then acts, and the engine performs its out-door stroke, at the end of which the valve is reversed, and the in-door stroke repeated as before.

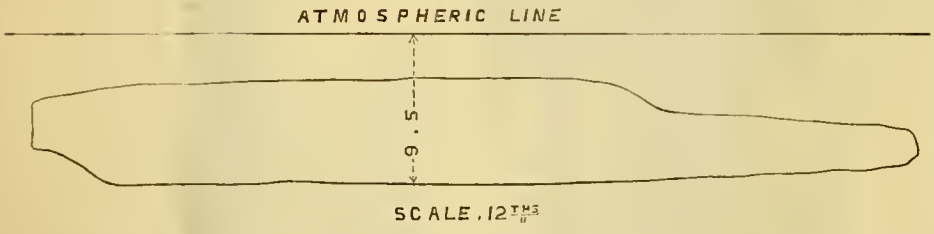
Fig. 6.




"The valve is moved by the plug-rod *f*. It has on one side two tappets, *h* and *i*, which strike against the lever *k*, and so raise or lower the valve, and put the cylinder port in communication with either the boiler or the condenser. The lever-shaft carries also a smaller bent lever *l*, acted on by another tappet on the opposite side of the plug-rod, the object of which is to bring the valves at half stroke into the position for shutting off the supply of steam to the cylinder. This latter tappet is movable, in order that any required degree of expansion may be used."

Besides the condenser, to which we have now alluded, there is the "gravity condenser;" but as in this a small pump is requisite for drawing off the air, which, being of less specific gravity than water, accumulates at the head of the liquid column, it scarcely falls within the limits of our treatment, where condensers without air-pumps only are concerned.

Fig. 7.




We now return to the "ejector-condenser," on which a few more words as to its origin require to be said. It appears from our own personal enquiry into the facts of this case, that the original conception, for all practical purposes at least, is due to a Mr. James Barclay, who in 1862 proposed to apply the Giffard injector to the exhaust-pipe of a steam-engine. This application, of which we have seen the original drawings made at the time above alluded to, is represented by fig. 4, which engraving is indeed reduced from the original drawings now in our possession, and the date of which is attested by numerous witnesses.

It was originally thought necessary to furnish the overflow passage of the injector with an air-pump, as at B, fig. 4, in order to form a vacuum, into which the water and steam would rush on starting the engine. As this, however, was found unnecessary in practice, we believe it never was used. By way, too, of completeness, we may add that this same James Barclay proposed at the time to call an ejector, when so applied, an "ejector-condenser," at least that is testified to on oath, by more than half-a-dozen persons who have been engaged on the long series of experiments made at Caledonia Foundry, with more or less interruption, since 1862.

Before concluding this paper, however, we feel it our duty, in order that this journal may contain a greater array of facts, which we cannot help regretting some of our contemporaries have endeavoured to suppress, to refer to the apparatus with which the experiments were made at Caledonia Foundry from the early part of 1865, and which same apparatus has since, with slight interruption, been continually in use, and at the time we are writing is in operation on an engine at these works. It is represented in the section, fig. 5, having the vacuum-guage A applied to the chamber surrounding the last or lowest nozzle. For a very long time its efficiency as a condenser was tested with live steam from the boiler, and it was not until after it had shown itself capable of producing a vacuum of 11 lbs. that Mr. Barclay felt warranted in applying it to an engine. Now that it is applied, the results are excelleut, as the diagrams, figs. 6 and 7, show. Our readers will not fail to observe that this condenser is constructed in correspondence with the drawing fig. 6 of Mr. Barclay's patent of 1864, No. 1,151.

In the latest experimeuts made at Caledonia Foundry a somewhat novel fact has been ascertained, namely, that the gradually widening throat or discharge-pipe is unnecessary; in fact the diagram fig. 6 was taken from the cylinders when the throat X was withdrawn, the engine making thirty double strokes per minute, and discharging the water into a *parallel* pipe of about two inches diameter. Diagram fig. 7 was taken when the engine was making forty double strokes and the throat or discharge-pipe in place as shown in the drawing fig. 5. On comparing these diagrams it will be noticed that fig. 6 (the throat being removed) shows a much better vacuum than fig. 7, where the throat is used: this difference in the vacuum is to some extent accounted for by the higher speed of the engine when the diagram fig. 7 was taken—a higher speed of engine, of course, causing a greater amount of steam to pass through the condenser; but as an additional passage of steam would also induce through the nozzle an additional amount of water, it follows that the depreciation of the vacuum from this cause alone cannot be considerable; hence there appears some strong ground for attaching importance to the absence of the throat.

The apparatus fig. 5 was made with the two steam entrances B and C connected by a passage D, so that the steam admitted through either or both branches would pass to the inner as well as the outer steam nozzles; but subsequently the passage was closed up by a plug E, in order that steam of different temperature and pressure might be used. The water-jet was started by steam entering from the boiler through the branch B, whilst the steam to be condensed for forming the vacuum was admitted by the branch C. It is only necessary to add, that the engine from which the diagrams figs. 6 and 7 were taken (as the diagrams themselves show) is driven by steam in the cylinder below the atmospheric pressure at the commencement of the stroke.—V. D.

## ON A NEW GAS-STOVE AT THE ROYAL OBSERVATORY, EDINBURGH; AND THE MANUFACTURE OF WATER.

By C. Piazzi Smyth, F.R.S., F.R.A.S., Astronomer-Royal for Scotland, &c.

In a little garret-room at the Royal Observatory, Edinburgh, there has been introduced a gas-stove, now for nearly a year, with remarkable success after certain principles were efficiently carried out. The proof of success is, 1st, that the temperature of the garret is now from 10° to 15° higher than a similar neighbouring garret without a stove. 2nd. There is a hot closet, where articles may be maintained night and day at a temperature of about 100°. 3rd. There is no bad air from the stove, and the garret is indeed sweeter than it used to be before the stove was erected, because

the means for conveying away the bad or burned air of the stove are made to remove the bad air from illumination or respiration of any occupants of the garret. 4th. There is no trouble either by day or by night, for the stove is kept constantly burning, and simply produces an accession of heat and comfort to the garret, as if the stove was a natural hot-spring, or "that it went like a clock." 5th. The expense is exceedingly small, on account of the trifling quantity of gas burned: though, that gas being also economically burned to a degree, there was a trouble at first connected with the fountain of water; of which more presently.

### Methods.

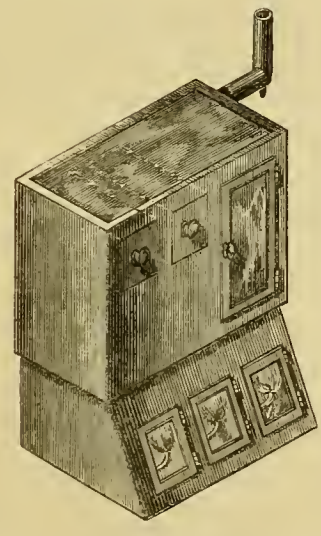
1. The supply of gas must be constant; there is, therefore, a regulator of pressure, through which the gas passes before entering the stove, and this completely prevents the flaring up and roaring of the gas-burners, which is experienced in ordinary gas-lights when the pressure is altered on the street gas-main, either by the Gas Company or by the shops turning on or off.

2. The gas is burned in ordinary small "fish-tailed," or "union," burners, of which there are three, of the smallest size manufactured; and, according to the season, either one, or two, or three are lit. They are preferred to the Bunsen-burners, from the cheerful light that they throw out at night through glazed doors in front of the stove; also from burning the gas at least as perfectly, if not more so, from the higher temperature of the bright flame; and also from not being subject to occasional back ignitions, and then smoking, as are the Bunsen burners.

3. The stove is made of sheet iron; it is 32 inches high, 25 inches long, and 18 inches broad at the bottom, but only 4 inches broad at top,—this decrease being produced by the front slanting backwards, as shown in fig. 1.

Fig. 1.

Fig. 2.



5. The heated products of combustion are not allowed to escape upwards to the top of the stove at once, but are made to pass backwards and forwards under four successive horizontal diaphragms, before arriving at the chimney, at the upper right hand corner. These diaphragms are fixed in their places by rivets which project outwards an inch. These serve to communicate the heat of the diaphragms to the outside air, as well as to hang things on to be heated or dried; and what with sides and diaphragms of the stove, the heated products of combustion of the gas-lights have to pass over 25 square feet of metal surface before escaping to the chimney. This is an excessively large amount of surface in proportion to the quantity of gas burned, and hence, in a large measure, the economy of the stove.

6. The hot closet is formed by a box or wooden head put over the upper half of the stove, and furnished with drawers and a closet door, as shown in fig. 2.

The top of the closet and the door are both of plate glass, so that the face of watches, if put inside to be tested for going at high temperatures, may be read as they lie there at these temperatures.

7. To carry away the gaseous products of combustion there is a chimney formed of a metal pipe 1·5 inch in diameter, which passes through a hole in the ceiling of the garret to the open air outside the roof; the hole being so much larger than the chimney pipe that its annular difference makes a chimney for the bad air of the garret as well.

8. In calm weather, the stove chimney and garret ceiling chimney both act well by the ascensional power of warm air; but in times of wind, the currents are more inclined to blow down than up, the situation being very exposed, and the winds violent to a degree.

9. To correct these downward currents, therefore, in times of wind (simple cowls having been found inefficacious), there has been established over the top of the two united chimneys a little vertical windmill, working a modification between an Archimedean screw and a fan-wheel, the conical blades of which are always drawing the bad air out of both chimneys, and expelling it to leeward. The action of this apparatus is most admirable, most necessary; for whereas the burning of a single *un*ventilated gas-light in so small a garret makes the air noxious in a quarter of an hour, the ventilated gas-burners keep on burning both by day and by night, and week after week without any smell or other bad feature being perceptible.

### Chimneys in Theory and Practice.

10. A word more on the chimney arrangements of the gas-stove, as applicable to any and all chimneys.

The usual circumstances under which chimneys smoke, or have back draughts, are,—at the chimney-top, where the products of combustion ought to escape, the winds are howling like ten tigers, and doing their utmost to get down the chimney, and so enter the fire-place room, where the fire, by burning and making some upward movement of the air in lulls between gusts of the tempest above, produces a rarefaction.

Architects generally seem to fancy that a principle merely is quite enough for actual practice anywhere; and, therefore, trusting that there is an ascensional tendency in hot air from a fire, though ever so small, inducing it to go up a chimney, they leave that often very weak, almost homœpathic force to contend single-handed against two difficulties—*first*, to wire-draw some air of supply through closed doors and windows; and *second*, to eject the burned air right in the face of the struggling winds and whirlwinds at the top of the chimney-pots. A very little calculation would show that the result must be practical failure, i.e., a smoky chimney, although the ascensional principle of warm air be perfectly true.

No person who lives in a very windy and trying locality can expect to be free from smoky chimneys, unless he corrects both of the evils above mentioned. Let him also, by all meaus, have as tall a chimney as he can; let him see that the top of it is not dominated by any neighbouring mass higher than itself; and let him keep the chimney-stalk as warm inside as he can, to promote the ascensional power of warm air; but let him also supply these two things. 1. A pipe to bring fresh air to be burned from the outside, top, and most windy part of the roof; and 2. A *power*-cowl to extract the burned air, and throw it out into the atmosphere, despite any number of winds howling to get in.

With the Observatory stove, there is an inch-pipe to bring fresh air to be burned in it, not exactly from the outside of the roof, but from a very windy region between the roof and ceiling, which does almost as well. And then for the ejecting of the burned air, there is a little vertical windmill working a diagonal screw fanner as aforesaid.

To those who want a tolerably large measure of efficiency and no trouble in such a *power*-cowl, I would say, get one of James Heworth's patent Archimedean screw ventilators; but to those who have a fancy for realising the utmost power of the wind according to Smeaton's laws for vertical windmill sails, and do not object to experimenting, I am inclined to say, try the Edinburgh Observatory plan of a vertical sail-wheel kept at right angles to the wind's direction by being at the *leeward* end of the wheel's horizontal axis (instead of the *windward* end, as with ordinary windmills, when they need a special and expensive apparatus to turn their faces always to the wind).

The collar-motion, by which the wheel's face is turned towards the wind, must be rather stiff than free or light; but the motion

of the axle of the sail-wheel round itself must be as free and light as possible : and to promote its always turning even in very light airs, the sails, which are plates of tin, are fastened at the most suitable angle for *beginning* to turn, and are fastened by their front edges only ; hence, when the wind blows strong, and the wheel is inclined to turn needlessly fast, the tail-ends of the sails are blown or bend more nearly in the direction of the axis of the wheel, and thus slow their motions and decrease the surface on which the wind can act.

### Manufacture of Water.

11. Let us now suppose that everything has been well-managed thus far with one gas-stove, viz :—

A. Its supply of gas is constant; B. the lights never go out; C. the supply of fresh air to it is always ample, whether doors and windows be open or shut ; and D. the extraction of the burned air by the chimney and *power*-cowl is also perfect, no bad smell being ever perceived. Still there is one thing to trouble our comfort—"water, water everywhere," and truly "not a drop to drink." Water issues out of every crack or pore of the chimney, perhaps of the stove also, and it is slobbered about on the roof above out of the cowl's top or out of the sides thereof. Where does all this water come from ?

It is the product of combustion ; the combination of the hydrogen of the gas with the oxygen of the air ; and this is indeed a means of manufacturing water in any place where we can get fuel and air. The Royal Observatory, Edinburgh, on the top of the Calton Hill, is unfortunately far above the level of the water-column of Edinburgh ; but its gas-stove up in its topmost perch, just under the roof, is manufacturing water both by night and by day ; and enough of that manufactured water is collected now to form a very useful tank of supply—the only supply, if ever the misfortune of a fire should occur.

But why does not water appear similarly, some one may ask, at every fire-place ; and why cannot our Southern travellers, dying for thirst in the wilderness, manufacture a supply of water for themselves by merely setting the grass on fire ? Merely this one difficulty—the fuel in these cases is not burned *economically*, or according to economy in warming, i.e., the heat is not sufficiently taken out of the burned gases : hence all the water these gases are carrying away is in a state of vapour very highly vaporised, and it refuses to deposit upon anything. But when, as already described in the Observatory gas-stove, the burned air from merely a single gas-burner is made to travel over 25 feet of conducting metal in the stove, its temperature has been so much lowered that the vapour of water hitherto held in suspension deposits almost immediately it enters the chimney, that chimney being in this case a metal tube, almost like the worm of a still reversed. At first it was a soldered tube made of zinc plate, but that leaked so determinedly and disastrously too, at all sorts of places, that it had to be substituted by a stout leaden pipe ; and this again, to prevent the chimney water running back into the stove, had to be made with a bend-down, before entering, or rather after leaving, the stove, as may be seen in figs. 1 and 2, that bend being further provided with a stop-cock or place of escape for the water that runs down to it.

At that point there is now a glass jar always placed to catch the water as it falls out ; and an exquisite sight it is when full, the water being colourless, clear to admiration, and refractive nearly as crystal—this latter quality arising from the salts held in solution, and which are probably enough, after all, to prevent drinking water being ever manufactured in this way, so long at least as it can be procured in any other, and men are not absolutely dying of thirst.

As to the quantity of water that is produced in this manner, I can only speak as to what forms in the *vertical* part of the chimney-pipe, for a long horizontal portion of the same beyond ejects its formation upon the open roof, and, evaporating there, makes a white, chalky-looking mess. But in the glass pot, under the vertical portion, there are caught in 24 hours, when all three burners are alight (consuming apparently a little under 120 cubic feet of gas in that time) 50·6 cubic inches of water.

## THE CANTOR LECTURES OF 1869.

The "Cantor Lectures" of last year were delivered at the Society of Arts, Adelphi—and for the first time, we believe, since their foundation, by an engineer—by Mr. John Anderson, General Superintendent of Machinery of the Royal Arsenal, Woolwich. The subject he chose was that of "Applied Mechanics," and with that title perhaps the lectures did not seem to promise much excitement, and, owing to it, may have attracted less general notice from the press than they intrinsically deserve. We the rather, therefore, call attention to them now, that they may be read and studied, in the "Journal of the Society of Arts" for 30th July, 6th, 13th, and 20th August 1869.

In the arrangement and treatment of his subject, Mr. Anderson has, in truth, taken a very wide and really philosophical view, and to many will perhaps seem to have passed beyond the limits which, to ordinary hearers, appertain to "Applied Mechanics." But the lecturer has fully discerned for himself, and extremely well put before his audience, that if "mechanics" are to be successfully "applied," their effectiveness of application must begin by our grasping fully, and with clear thought, the nature of the material world, to and through which alone the abstractions of theoretic mechanics can ever become applied and show themselves in concrete and useful realities. Hence, he really starts, after a very good and interesting history of the steps of the human family in arts and mechanical works and manufactures, with physics in certain broad and applicable aspects. The second lecture passes in review the chief properties of the materials of construction, and in the variety and curious nature of the phenomena, the facts adduced, with their relations and explanations, this lecture does not yield in interest to any one of the course. The third, though it embraces a good deal else besides, deals chiefly with the molecular constitution of metals, and the relations of these to the practical treatment of the metals themselves in moulding and casting, forging &c., and in the applications of the metals so fashioned, whether it be to a needle or a projectile, in relation namely to use of a material proper or improper.

The last lecture deals with results, and passes in review the great achievements which have been made in applying physics and mechanics to the production of labouring force in modern times. In illustrating these in various aspects and relations, there is frequently evinced a great deal of racy originality of thought and reference, and some good philosophy at the end, in showing that great as have been our advances, the mine of future discovery is as inexhaustible as it was when mankind knew but rude implements of flint or stone.

Mr. Anderson has added to his professional reputation, and justified the choice of the Cantor trustees, by these lectures.

## NELSON'S IMPROVED CALORIC INTERCEPTOR.

This improved Caloric Interceptor is manufactured by Mr. James Nelson, Bonner's Field, Sunderland, and is applicable to all exposed surfaces of boilers, steam-pipes, cylinders &c.

It is superior to felt in many respects, and cheaper ; it requires neither straps nor bindings, and is very durable, strong and tenacious, yet sufficiently elastic to expand and contract with the boiler. It also possesses the great advantage of at once giving indications of leakage, by showing a black mark, and thus prevents the awkward expedient of stripping off all the covering, as in the case with felt, it being only necessary to cut out the portion where the leak actually is, which is easily replaced. It is quite impervious to weather, and is not inflammable. It has been proved to be very beneficial in steam-ships, as it keeps the engine-room and stoke-hole cool, and protects the decks from the action of the heat.

## SIEBE BROS.', ENGINEERS (WORKS, MASON STREET, LAMBETH) PATENT IMPROVED DIRECT-ACTING ICE-MAKING MACHINE.—WITH STEAM ENGINE, FITTED TO A VERTICAL STEAM BOILER.

(*Illustrated by Plate* XIV.)

Plate (XIV) this month illustrates the latest form of Ether Ice-making Machinery of Messrs. Siebe Bros. Fig. 1 is an elevation of the ice-making machine, showing the refrigerator and condenser in section; and fig. 2 is a vertical section at right angles to fig. 1.

As the mechanical reader will at once see, this machine consists of a coffee-pot boiler, attached to which at one side—or rather at back of the fire door—is a small direct-acting one horse-power engine,—transmitting by a very simple arrangement of pin and cross slide, its motion to the solid piston of the double-acting air-pump, immersed in liquid, and the valves of which are of vulcanised India-rubber, and so made that the flat piston at each end of the stroke comes quite home against the ends of the cylinder—the only true principle of construction for any good or economical air-pump. At one side is the refrigerator A and at the other the ether condenser C, and the whole machine may be placed upon a low roller carriage, so as to be portable. This simple little apparatus, making 25 lbs. of ice per hour, is quite a recent introduction, and answers a want that has been very frequently expressed for some years past. One of its peculiarities is that no freezing-box is required, the water being frozen direct by the volatile liquid during evaporation.

It is especially adapted for small communities, up-country stations, hospitals, hotel or barrack use, and on board ship, or where the demand for ice is too limited for employment of the larger or commercial ether apparatus.

There is no well-appointed chemical or physical laboratory upon a large scale, as in colleges or public institutions, which ought not now to be provided with one of these machines as part of its apparatus. Experiments on the properties of bodies at very low temperatures have hitherto been very infrequent, simply because the means of obtaining such temperatures were so difficult, limited in power, and expensive.

The mechanical arrangements possess but few working parts, and the vertical tubular boiler, of the best Staffordshire iron, is tested by hydraulic pressure to 100 lbs. on the square inch. No foundations are required; the machine may be placed upon an upper floor, or in any odd corner; the space occupied is about 6½ feet long, 3 feet wide, and 5½ feet high.

The cost of working this apparatus is the attendance of one person and from 5 to 6 lbs. of coals per hour, and an insignificant loss of ether. It will make about 30 lbs. of ice cream per hour. Where it is desirable to use wood for fuel, the fire grate is enlarged for the purpose.

The power required is one horse nominal. The charge of ether is about 2 gallons, or about 14½ lbs. avoirdupois. The refrigerator contains 21 ice tubes, holding 2½ gallons or 25lbs. of water, or 25 lbs. of ice hourly. The boiler, engine, and air-pump are sent from the works without being detached, and weigh about 10 cwt. The refrigerator and condenser form a second package, weighing about 2 cwt., and the apparatus stows into about 20 cubic feet, ship measurement, of 40 per ton.

The above production is based upon the temperature of the atmosphere in England, and water at 60° Fahrenheit. In a climate like that of India, the 25 lbs. of ice would probably require 70 to 80 minutes for production.

With three or four machines such as this, one taking up a refrigerated liquid from the other, and so reducing the temperature more and more, and one specially contrived to work with liquid carbonic acid, or solid carbonic acid and ether, or some even more volatile fluid to finish off with, there is a certainty that reductions of temperature might be attained such as have never been reached yet by any physical philosopher. Probably no experimentalist has ever yet produced a cold of 150° Fahrenheit below the temperature of freezing water—a range quite insignificant compared with the 2,000° or 3,000° of our best furnaces in the other direction.

Why should not the Royal Institution put such apparatus at Professor Tyndall's command, and enable him to show us what those five or six chemical fluids (all, we believe, organic compounds) which have never yet been frozen, or even rendered viscid by cold, will appear, when rendered solid, as water is when it crystallises into ice?

## SODA MANUFACTURE ON THE TYNE.

By R. Calvert Clapham, Esq., F.C.S.

(*Continued from page* 178.)

In looking back, for about the same time, I find that the wages of ball-furnacemen, and other skilled soda men, were as follows:—

| | | | |
|---|---|---|---|
| In 1810 | the Wages were | 14s. | Per Week. |
| „ 1817 | „ | 16 | „ |
| „ 1824 | „ | 16 | „ |
| „ 1830 | „ | 17 | „ |
| „ 1835 | „ | 17 | „ |
| „ 1840 | „ | 21 | „ |
| „ 1843 | „ | 21 | „ |
| „ 1850 | „ | 22 | „ |
| „ 1860 | „ | 24 | „ |
| „ 1868 | „ | 27 | „ |

At the same time that wages in soda works have nearly doubled during this time, the quantity of work turned out by a workman has more than kept pace with the wages paid, and may be said to be at least four times as great. This appears to be due jointly to the increased skill of the workman, and to the better appliances and apparatus provided by the manufacturer.

From the commencement of Le Blanc's process, even to the present day, the difficulty has been to devise furnaces or apparatus to meet the scientific improvements suggested.

In decomposing salt, the first furnaces were constructed of lead, lined with brickwork. The charge of salt was 2 cwt., and the sulphuric acid required was slowly poured upon it from a carboy, through a hole in the top of the furnace. The hydrochloric acid produced was allowed to escape into the air by means of a short chimney. The operation was completed in about three hours, when a plug was withdrawn from the side of the lead pan, and the semi-fluid mass allowed to run into a lead cooling vessel, where it formed itself into a hard cake, resembling ice or glass. This was broken up and furnaced for sulphate of soda; but, as these lead furnaces were very soon worn out, a fire-brick furnace was substituted in 1828, long known as a "dandy furnace." A great improvement upon this plan was introduced in 1840 by Mr. John Lee, who suggested the use of a metal pan about nine feet diameter, in the place of the furnace; and its adoption has led to a large saving in the sulphuric acid formerly employed.

On the repeal of the duty on salt, in 1823, a great development in soda works shortly followed. Next to Mr. Losh came Mr. T. H. Leighton, who commenced at Blyth in 1822, and used salt made from sea water, and decomposed by copperas. He afterwards purchased sulphuric acid of Doubleday and Easterby, at Bill Quay, and from Tennant and Co., at Glasgow, which cost 18*l.* 10*s.* per ton.

Cookson and Co. (now Jarrow Chemical Co.), began, in 1823, by the erection of chambers and furnaces in the middle of South Shields; they removed a few years afterwards to Jarrow Slake, where very extensive works are now carried on.

John Allen commenced at Felling Shore, in 1827; A. Clapham at Friar's Goose, in 1829; C. Atwood (now Allhusen and Sons), at South Shore, in 1830; and H. L. Pattinson, and Co., at Felling, in 1834.

A similar development took place in Lancashire, Muspratt having commenced in 1824, Crossfield and Gamble in 1827, and many others followed.

At the same time that the increase in the manufacture of soda was going forward, little or no attention was paid to the condensation of the hydrochloric acid, and large quantities passed off into the air, doing considerable damage to vegetation, and resulting in heavy legal expenses. Various methods were attempted to condense it. The first experiments at Walker were made in 1827; and later on, about 1835, Mr. W. S. Losh put down long underground flues, into which jets of water were forced by means of an

engine. A large wood chamber was also put up for the gas to pass into, which was also supplied with water by the same means. This was in imitation of the lead chambers used in France as condensers. Mr. John Allan also tried long flues at the Felling, one running nearly all round his works. Towers constructed of stone and filled with glass, or flints, were also put up; but for the most part all these were failures, or at least were imperfect, and to get over the difficulty high chimneys were erected;—one object being to spread the gas over a greater surface.

It was in these difficulties that Mr. Gossage (to whom the Alkali Trade is so much indebted for many other improvements) took out a patent in 1836, for condensers packed with coke. His plan was generally approved by manufacturers; and under ordinary circumstances, it is capable of condensing the whole of the hydrochloric acid produced. Mr. T. H. Burnett also took an active part in the introduction of condensers in this district; but it was not till 1843 that condensation was generally carried out on the Tyne, and even some years later than that date, when the perfect system which is now adopted came into general use.

I have already referred to the time when bleaching was effected without chlorine. Bertholet was the first to suggest, in a paper to the French Academy, the use of chlorine in bleaching. This was in 1785. In 1787 Professor Copeland and the Duke of Gordon commenced works in Aberdeen to make chlorine in large glass Woolf's apparatus. This was afterwards improved by the apparatus being made of hard wood. The mixtures used were :—

½ lb. of good Manganese.
1 „ „ Salt.
12 oz. „ $SO_3$.
12 oz. „ HO.

Bleaching by means of chlorine was introduced to the manufacturers of Glasgow in 1789 by Mr. Watt the engineer, and it soon found its way into Lancashire. As the demand for chlorine increased, the apparatus for its production was enlarged, and a vessel constructed of strong lead, fixed in a metal jacket, was substituted, a stone agitator being used to mix the charge of salt, manganese, and sulphuric acid. The chlorine passed off into water, and was sold in that form in carboys to the bleachers. It was ascertained by Javille, in 1790, that a little caustic potash added to the water, was the means of adding strength to the bleaching liquor, and this plan was introduced into Liverpool, and a small work established for its manufacture, in 1792. A further improvement was effected by Mr. Charles Tennant, of Glasgow, in 1798, who introduced lime into the water, in the place of potash; and, in the following year he took out a patent for dry hydrate of lime in absorbing chlorine, which soon entirely superseded all other plans previously in operation.

Bleaching powder was first made on the Tyne, by Losh, Wilson, and Bell, in 1830. The first operations were conducted by using muriatic acid, at 30° Twadell's (made in the works by retorts), and finely ground English manganese, then testing about 84 per cent. Two lead stills were put up at first, and two chambers made of wood, and covered with pitch. In time two other stills were erected, and these four stills did all the work required till 1843, when the concern was handed over to the present Alkali Company.

In 1830, the proportions for a charge were :—

10½ cwts. of Lime
12 „ Manganese
24 „ Muriatic Acid

and produced 13 cwt. of bleaching powder, testing about 26 per cent.

In the following year (1831), the mixture was changed to—

10 cwts. of Manganese
10½ „ Lime
35 „ Muriatic Acid
7½ „ Sulphuric Acid

and produced 15½ cwt. of bleaching powder.

In 1832, the mixture was again changed to :—

9 cwts. of Manganese
10 „ Common Salt
9 „ Sulphuric Acid
10½ „ Lime

and produced 14½ cwt. of bleaching powder.

From April 1832, the process consisted in using salt, manganese, and sulphuric acid.

On September 9, 1843, the process was changed to the present plan of using hydrochloric acid, obtained by condensation, and manganese. The quantities produced at first were as under :—

In 1820—Not known
„ 1830— 73 tons
„ 1832—109 „
„ 1841—370 „

In 1867 (as before stated) the produce of bleaching powder on the Tyne had increased to 27,000 tons.

When Mr. Charles Tennant commenced making dry bleaching powder, in 1799, the price was 1*s.* 6*d.* per lb., or 168*l.* per ton, and the following are the prices since that time :—*

| | | | | |
|---|---|---|---|---|
| In 1805— | £120 | 0 | 0 | per ton. |
| „ 1810— | 84 | 0 | 0 | „ |
| „ 1815— | 80 | 0 | 0 | „ |
| „ 1820— | 47 | 0 | 0 | „ |
| „ 1825— | 27 | 0 | 0 | „ |
| „ 1830— | 23 | 0 | 0 | „ |
| „ 1832— | 21 | 0 | 0 | „ |
| „ 1835— | 23 | 10 | 0 | „ |
| „ 1840— | 21 | 0 | 0 | „ |
| „ 1843 — | 21 | 0 | 0 | „ |
| „ 1846— | 18 | 10 | 0 | „ |
| „ 1847— | 14 | 10 | 0 | „ |
| „ 1848— | 13 | 10 | 0 | „ |
| „ 1850— | 13 | 15 | 0 | „ |
| „ 1855— | 10 | 15 | 0 | „ |
| „ 1857—‡ | 13 | 10 | 0 | „ |
| „ 1860— | 11 | 0 | 0 | „ |
| „ 1868— | 10 | 12 | 0 | „ |

Up to 1815, an excise duty of 30*l.* per ton was laid upon the waste products from bleaching powder stills; and therefore it was not till some time after that date that the sulphate of soda contained in the still liquors was used in making alkali. Mr. Tennant was one of the first to begin, and considerable quantities were made from this source, and many patents taken out for so doing.

Messrs. H. L. Pattinson & Co. were the first to put up stills on the present system. This was in 1842. In 1846, Mr. W. W. Pattinson took out a patent for the internal application of steam to the stills, which has added much to the efficiency of working.

* I am indebted to Mr. John Tennant for this information and other particulars.
‡ During 1857, the price rose to 18*l.* per ton.

## MECHANIC'S LIBRARY.

Adcock's Engineers' Pocket-Book, 1870. 12mo. roan tuck.
Atchley's Builder's Price-Book, 1870. 12mo. 4s. cloth.
Bermuda Floating Dock, Narrative of Voyage of. 12mo. 5s. cloth.
Binns' Second Course of Orthographic Projection. 8vo. 10s. 6d. cloth.
Campin's Principles and Constitution of Machinery. 12mo. 6s. cloth.
Johnston's Hand-Book of Physical Geography. 12mo. 3s. 6d.
Kelly's Builder's Price-Book, 1870. Cr. 8vo. 3s. cloth.
Latham's Dictionary of English Language. 4 vols. 4to. 7*l.* cloth.
Lefébre's Marvels of Architecture, translated by Donald. Cr. 8vo. 5s.
Lyle's What are the Stars? 12mo. 3s. 6d. cloth.
Pick's Etymological French Dictionary. 8vo. 7s. 6d. cloth.
Spon's Dictionary of Engineering, by O'Byrne. Div. II. 13s. 6d.

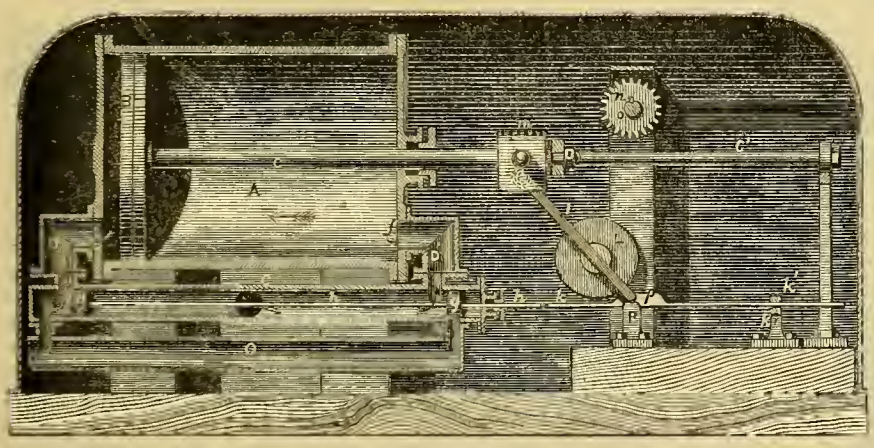
## RECENT PATENTS.

### WATER METERS.

John Withers, *Handsworth, Stafford.—Patent dated May* 10, 1869.

This invention relates to a peculiar construction, arrangement, and combination of apparatus for measuring liquids and for registering the quantity measured, and consists in combining one or more horizontal cylinders of any known capacity provided with pistons and rods working through stuffing boxes with self-acting inlet and outlet valves and self-acting slide valve for directing the flow of the water to each end of the measuring cylinder or cylinders alternately. According to one arrangement the patentee fixes to the outer ends

of the measuring cylinders a cylindrical valve case, having two lateral openings communicating through the end of the measuring cylinder with the interior thereof. In each of these valve cases work two piston valves, so disposed that, when one of the openings, say the inlet, is open to the cylinder, the other or outlet shall be closed, and *vice versâ*. The spindles of these piston valves may be connected together by an oscillating beam or lever, which causes one pair of piston-valves to descend when the other is ascending, the pressure of the water in the inlet pipe leading to the cylindrical valve cases alone serving to work the valves. In order to direct the flow of water into the opposite ends of the measuring cylinder or cylinders alternately, he adapts a suitable valve or valves to the inlet pipe or pipes, which valves he works by the aid of a weighted lever acted upon by a moveable or fixed arm or projection at each stroke, so as to cause the weighted lever by its impulse to change suddenly the position of the slide or other valve or valves. The counting or registering mechanism may be worked by a pinion gearing into rack-teeth formed on the measuring piston-rod, or by any other suitable mechanical contrivance for transmitting motion from such rod. The whole is enclosed in a suitable framework or casing.



The above engraving represents a longitudinal section of an arrangement wherein a single measuring cylinder only is employed in lieu of two, as in the first described arrangement. A is the measuring cylinder, B the piston working therein, and C the piston-rod, provided with a cross head which slides along the guide rods C'. This rod C carries a rack *m* for actuating the counting mechanism through the pinion *n* on the spindle *o*.

This rod also carries a pendulous weighted lever I, having a bob weight L on its lower extremity, which actuates the inlet valves in the manner hereinbefore explained; *e* and *f* are apertures made one in each end of the measuring cylinder A, such apertures communicating respectively with the branch pipes D D', which communicate with the opposite ends respectively of the inlet pipe G. Other openings in this inlet pipe communicate with the outlet pipe O, and all these openings are alternately opened and closed as required, by the piston-valves *g g'* carried by the one valve spindle *h*. To the outer end of this valve spindle there is attached a slotted frame *k*, guided in its longitudinal movement by the fixed guide *k'*; P is a fixed projection over which the lower end of the weighted lever I is drawn at each stroke of the piston B. In order to prevent the end of the lever I from leaving the slot in the piece K when elevated, by passing over the projection P, the slides of the slotted piece are raised slightly, as at *p*. The engraving represents the water as entering the cylinder A from the inlet pipe G by the inlet aperture *f*, the valve *g'* being in such a position as to close the communication at that end with the outlet pipe O, whilst at the same time the water is being expelled from the opposite end of the cylinder through the aperture *e*, into the outlet pipe *o*, the valve *g* being in such a position as to bring the outlet pipe into direct communication with the interior of the measuring cylinder just before the piston completes its stroke in either direction; the tail of the weighted lever I slips off the projection P, and the weight L causes the lever to strike against one end or the other of the slotted piece *k*, thereby suddenly reversing the positions of the two valves *g g'*, when the operations above described are repeated, and the water is admitted to the reverse end of the measuring cyli nder and soon, each alternate stroke being duly counted by the counting mechanism.

## TREATING OR REDUCING ORES.

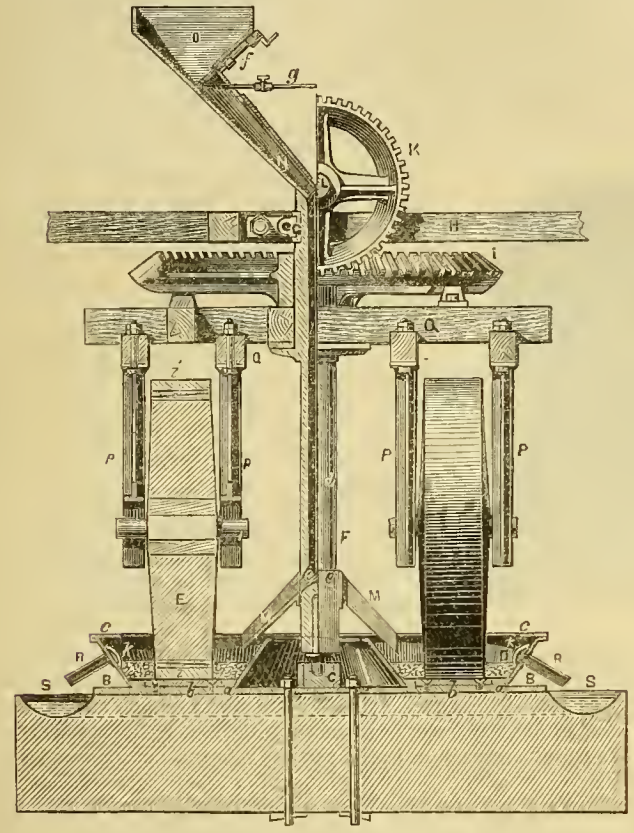
William Benson, *Hexham, Northumberland.—Patent dated May 18, 1869.*

This invention has for its object the more effectually and speedily reducing ores or minerals for the purpose of washing or separating them either from one another or from certain of their constituents, and consists in the employment for that purpose of an arrangement of edge runners in place of stamps which have hitherto been employed. The ores or minerals are fed to the runners by means of an upright hollow shaft, the lower portion of which is provided with lateral openings and inclined spouts, over which spouts and through the openings in the shaft the ores or minerals are carried by thin streams of water to the bottom of the pan or saucer and underneath the edge rolls, by which means the ores or minerals are ground or reduced to a fine thin sludge or "slime." This is afterwards carried off through openings in the side of the pan or saucer for subsequent treatment, wire gauze being placed over the mouths of the openings to prevent the passing through of any material not sufficiently crushed; or the ores or minerals may be fed under the runners by spouts or conduits from the exterior, or through the rim of the pan or saucer. By this means a uniform and thin feed of the ores or minerals is continuously attained.

The annexed engraving (page 254) is an elevation, with one half in section, showing one of the modes of feeding or supplying the ores or minerals under the edge runners. A is a bed or foundation of masonry, upon which are bolted the circular bed-plate B and footstep bearing C. Two concentric annular projections *a* are cast on the surface of the bed plate, which constitutes the bottom of the annular trough or saucer D, the sides of which trough are cast with or secured at their lower edges to the undercut or dovetailed edges of the raised annular projections before referred to. Between these annular projections is screwed an annular steel or chilled cast-iron plate *b*, forming the surface upon which the edge runners E E operate. An internal projecting rim or flange *c* is bolted round the outer rim or edge of the annular trough in order to prevent any accidental escape of the semifluid material contained in such trough over the rim thereof. F is a vertical shaft turning in the footstep bearing C and in a collar bearing G fixed to the main framing H. This shaft carries a large bevel wheel I in gear with the bevel wheel K fast on the driving shaft L and thus receives a rotatory motion therefrom. The upper portion of the shaft F is made hollow, as shown at *d*, and, by preference, with the hollow portion slightly expanding downwards, in order to avoid any risk of the passage being choked up by the lodgment of fragments of ore or mineral therein; *e e* are two lateral openings made in the shaft and communicating with inclined spouts M M, which project over or into the annular trough D. The interior of the upper end of the shaft is expanded sufficiently to receive the lower extremity of an inclined spout N in connection with a feeding hopper O, for supplying the ores or minerals to be treated to the edge runners, or a funnel may be placed therein for that purpose. This hopper may be provided with a regulating slide *f* and with a pipe and stop-cock *g*, for introducing a jet of water into and amongst the small or crushed ores or minerals on their way down the spout N to the tubular shaft F. The top of the spout N may be made to open on hinges, as shown at *h*, for the purpose of clearing the same in case of obstruction, and cross bars may be fitted across the mouth of the hollow shaft F in order to prevent the entrance of fragments of ore

or mineral of a size which would be liable to choke up the passage and outlets below. P P are the yokes for propelling the edge runners; they are bolted to the cross beams Q Q, which are secured to and revolve with the vertical shaft F. The crushed ores or minerals to be operated upon are supplied to the feeding hopper O by elevators or otherwise, and descend thence along with a small stream of water from the pipe *g* into the trough or saucer D through the spout N, tubular shaft F, and inclined spouts M M, which direct them under the edge runners. These latter as they travel round reduce the hard substances to a powder by crushing or grinding them between the steel or chilled cast-iron bed plate *b* and the steel or iron rim or tire *i*, keyed on to the stone runners. As the substances are reduced they form, in conjunction with the water, a thin "sludge" or slime, which flows out of the trough

Fig. 2.




through the pipes R R, carrying with it in mechanical suspension the finely pulverised or reduced ores or minerals, and discharging the same into an annular gutter S, whence the sludge is removed for the subsequent processes of making and separating the solid contents; or the pipes R R may be made to convey the semifluid material direct to the place where it is to be further treated. The pipes R R are provided with wire gauze *k* in order to prevent any large or uncrushed substance from passing through them.

## BREECH-LOADING FIREARMS.

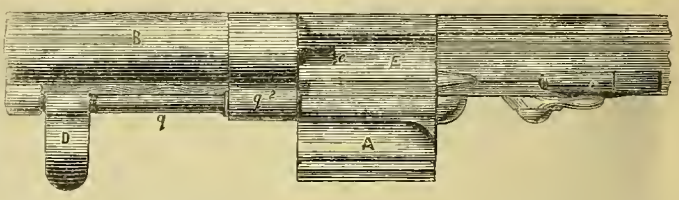
JOHN HENRY JOHNSON, 47 *Lincoln's Inn Fields; a Communication from* ROBERT ERRETT STEPHENS, *Owensound, Canada, and* JAMES *and* GEORGE DAVIS FERRIER, *Montreal, Canada.*—*Patent dated July* 1, 1869.

THIS invention relates to a peculiar combination and arrangement of the several parts of a breech-loading firearm, whereby the act of cocking the arm is made to throw open the breech and dislodge the shell of the exploded cartridge simultaneously and automatically.

The invention will be understood on reference to the annexed engravings, of which fig. 1 is a plan of the gun with the breech open; fig. 2 an elevation of the lock action and section of the barrel and stock; fig. 3 a detail view of the breech-opening and shell-extracting apparatus; and fig. 4 a detail plan of the same.

The breech-piece A consists of a block of metal or steel, of the general form shown in the engravings, which is thrown on the right-hand side of the barrel B by cocking the hammer C; and when the charge is in the chamber, the breech is closed by compressing a thumb-bit D connected therewith to its position against the barrel by the left hand of the operator, when the arm is again ready for firing. E is the shoe into which the breech-piece fits, and which is provided with a slot *e* for the movement of the cartridge-extractor F, which is constructed in the form shown in figs. 2, 3, and 4. The object of this part of the apparatus is to remove the shell of the exploded cartridge, which it does by the action of a cam rod G and spiral spring H. The cam rod G is actuated by the cocking of the hammer, when being cocked, through the intervention of the curved extension I of the tumbler K with the latch L, which is attached by a pivot connection to the upper end of the elbow $G^1$ of the cam rod G. To the upper end of this elbow $G^1$, on its inner side, there is attached a short bolt $G^2$ for the purpose of securing the breech-piece A in its position in the shoe E; $M^1$ is a flat link secured by a pivot connection at its lower end to a suitable projection $N^1$ of the trigger P, and at its upper end works

Fig. 1.




against and lifts the latch L by coming against the pin $n^2$ in such latch, and detaches it from the curved extension I of the tumbler K, when the trigger is pressed. This motion is used for the purpose of cocking without opening the breech. The trigger *n* is of the form shown in fig. 2, and differs from the ordinary form of trigger, in being provided with the extension $n^1$, to which the link or bar $m^1$ is attached; *o* is a shipper or adjustable incline, composed of steel, and attached to the case of the firearm by a screw, and it detaches the latch L from the curved extension I of the tumbler K, when the motion of the various parts brings the latch L in contact with the inclined or curved end of the shipper *o*. The shipper *o* may be adjusted in its proper position by a slotted screw hole, as shown in

Fig. 2.

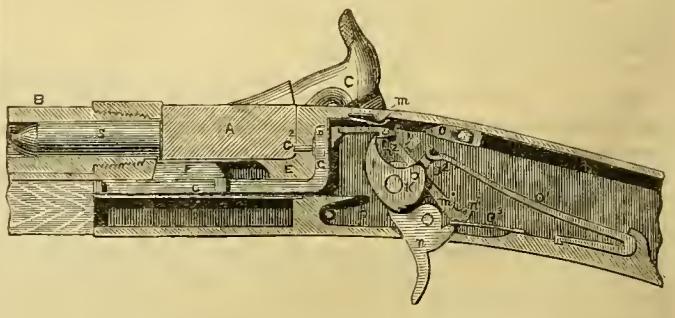



fig. 2; $o^1$ is the main spring attached to the tumbler K by a link $o^2$, and $o^3$ is the ordinary trigger spring; P is an internal lock plate of the form shown in fig. 2, and which serves for holding and securing the lock mechanism in place; *q* is a spindle placed on the outside of the gun in suitable bearings; it passes through the breech-piece and is secured to it by a screw, enabling the two to partially rotate together. Near the centre of this spindle is arranged a spiral groove $q^1$, placed under a centre bearing $q^2$. On the extreme or outer end of this spindle *q* is attached the thumb-bit D, for the purpose of operating the breech-piece by the left hand. The object of this spiral groove $q^1$ is to receive motion from a cam $q^3$ attached to the cam rod G, which in turn is actuated by the latch L, the curved extension I of the tumbler K, and the hammer C. The movement of the spindle *q* consequent on the spiral groove $q^1$ and

cam $q^3$ serves to throw open the breech simultaneously with the drawing of the hammer to half-cock; $r$ is a spiral spring, for the purpose of throwing the cam rod G and extractor F back into position when the latch L is relieved from the curved extension I by the action of the shipper $o$; S is the cartridge, the needle employed being of the ordinary description.

The mode of operation is as follows:—The various parts having been arranged as described, the hammer C is raised to half-cock; this has the effect of throwing back the breech-piece A by the action of the tumbler K, which is attached to and moved by the hammer; the curved extension I, being in contact with the latch L, draws it and the cam rod G backwards, at the same time withdrawing the locking-bolt $G^2$. The cam rod in turn gives motion to the cam $q^3$, which, working against the spiral groove $q^1$, causes a partial rotation of the spindle $q$, and at the same time throws open the breech-piece A. As the hammer reaches half-cock, the latch L, coming in

Fig. 3.

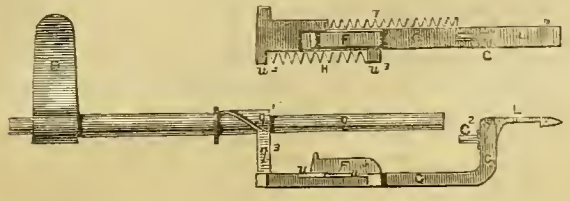


Fig. 4.



contact with the shipper $o$, is detached from the curved extension I of the tumbler K, and is returned to its position by the action of the spiral spring $r$. The cartridge is then inserted into the shoe E, and passed into the chamber by the thumb of the right hand. This being done, the fingers of the left hand, by means of the thumb-bit D, bring back the breech-piece A into its position in the shoe E, where it is securely locked by the bolt G passing into the hole $G^2$ by the action of the spiral spring $r$. The gun is then put at full-cock, and is ready for firing. The firearm is discharged by pulling the trigger, as in ordinary cases, and forcing the needle into the cartridge. The curved extension I of the tumbler K, coming back into its position, engages with the latch L. In operating the gun, if rapid firing is required, it may be brought at once to full-cock.

To remove the exploded cartridge prior to reloading, the operation of opening the breech is repeated; the shoulder $u$ on the cam rod G comes in contact with another shoulder $u^1$ on the extractor F at the instant the breech-piece clears the chamber. This contact of the two shoulders $u$ and $u^1$ loosens the shell of the cartridge, which is immediately ejected by the action of the spiral spring H, which had been previously compressed between the projection $v^2$ on the cam rod G and the projection $v^3$ on the extractor F respectively. The firearm is then ready for reloading, as before described.

## LAW REPORT.

FRILLS AND TRIMMINGS—WRIGHT *v.* HITCHCOCK.—Court of Exchequer, before the Lord Chief Baron, Mr. Baron Martin, Mr. Baron Channell, and Mr. Baron Pigott, January 11, 1870. This case was tried before the Lord Chief Baron at the sittings after last Term, when a verdict was found for the plaintiff on all the issues. The action was for the infringement of a patent for the manufacture of frills and trimmings by machinery.

Mr. Manisty, Q.C., moved for and obtained a rule to enter the verdict for the defendant.

Against this rule Mr. Grove, Q.C., Mr. Webster, Q.C., and Mr. Aston now showed cause, and Mr. Manisty, Q.C., and Mr. Macrory supported it.

It was urged that the trimmings were in character like trimmings made in the old-fashioned way, viz. by hand; and, therefore, the sale of them by any person was no infringement. It was, however, shown that the defendant's trimmings, with labels, bearing the words "Orr's Patent Trimmings," were sold. From the correspondence in the case it appeared that Mr. Orr had instructed his solicitor to defend the case, and it was found by the verdict of the jury that the machine used by Orr in the manufacture of his trimmings was similar to that patented by the plaintiff. The defendant, besides denying infringement, alleged that the invention claimed was not the proper subject-matter of a patent.

The arguments consumed nearly the whole of the day, and at the conclusion of them the Court concurred in upholding the finding of the jury, and decided that the objections urged against the patent ought not to prevail, and discharged the rule.

## REVIEWS OF NEW BOOKS.

*Zinc as applied to Roofing Purposes.* By Frederick Brabey & Co., Agents in London for the Vieille Montagne Company. Small folio. Illustrated. Published at the offices, 17 Gracechurch Street, London, 1869.

THIS, though but a trade circular of the higher sort, contains a vast deal of very valuable information as to the proper methods of applying the fine pure sheet zinc of the Belgian zinc makers to roofing, with tables of weight and costs, &c. It ought to be in the hands of every architect and clerk of works and in our engineering libraries.

*The Transactions of the Society of Engineers.* Vol. for 1868. Spon, London, 1869.

THIS large and well printed and illustrated volume sustains the character due to its predecessors, and shows that the society from which it comes forth is doing some good and real work. Besides the President's address it contains two papers of much interest by Dr. Edward Cullen, on the long-proposed ship canal through the Isthmus of Panama; and one on the Panama Railway. There are seven other papers of greater or less importance,—of none are we called upon to express any disparaging opinion.

*Statistics of Invention, illustrating the Policy of a Patent Law.* Part 2. By Henry Dircks, C.E.

THIS is another very good pamphlet by the author, intended to expose the fallacious arguments and unfair statements of Mr. Macfie and others of the would-be patent law abolitionists; for the present, at least, we are really tired of the subject. If the question of abolition is to come to a fair stand-up fight in the next session of Parliament, or any subsequent one, and the genuine intelligence and sense on the question of the technically productive part of the community be fairly taken first, we have no fear for the result. That which we have to be on the alert against is some adroit side-winded method of compassing the end without any fair hearing. Patent law abolition is in reality nothing more with those most loud-mouthed upon it but "a cry" for Parliamentary, or professional or personal influence, echoed by a few professional or other toadies whose bread and butter is more or less in the others' hands.

The public at large care nought about it, and so far do not in the least understand the subject.

*Link Motion and Expansion Gear Practically Considered.* By N. P. Burgh, Engineer. To be completed in 10 parts. Parts I. to V. 4to. Spon, London, 1869.

So far as this work has yet gone it bears promise of being a useful addition to the English literature of its subject, which, whether viewed theoretically or practically, is of an importance second to nothing to the engine-builder of the present day.

Mr. Burgh in all his works is thoroughly at home whilst he sticks to practice and to the best examples; and here he does so. He says: "Excepting in the work on 'Modern Marine Engineering,' there is no literature that contains practical descriptions and illustrations of link motion and expansion gear." He has, therefore, put himself into communication with the principal mechanical engineering firms of England and Scotland for the purpose of making this (his work) the standard reference on the above subjects.

Inserting the word "English" we agree with the first part of this statement, yet cannot but hope that Mr. Burgh is not unacquainted with the mine of German literature of his subject which exists, and out of which he will do well to extract the best of the ore, of a practical sort at least, which he may find in it.

As regards the result of the latter part of his paragraph, Mr. Burgh gives the names of *sixteen* of the principal engineering firms who have already contributed designs &c. to him for publication in the forthcoming parts. The size is small 4to., but many of the plates, which are clear and well-executed in light and dark outlines, are folding ones. The letterpress, so far, is in the author's best style, and is part of an exhaustive descriptive history of all the contrivances and "dodges" for valve-gear &c. that have been produced or published.

*The Theory of Strains in Girders and Similar Structures &c. &c.* By Bindon B. Stoney, B.A., C.E., Engineer to the Corporation for Improvement of the Port of Dublin. 2nd edit. 2 vols. 8vo. with numerous illustrations. Longmans, London, 1866-1869.

That "the proof of the pudding is in the eating" is a pretty safe proverb to apply as a guide to the genuine merits of scientific books. Addressed to a necessarily limited and special class of readers, they seldom are, and, in the long run never can be, buoyed up above their legitimate plane of intellectual flotation, in the way that "the new novel" or "the last tribulation," or the like, can be by advertisement and puffing. In fact, there is, we believe, but one sort of scientific book which can be, and often is, kept afloat without one shred of merit to recommend it, namely, the professor's class-book. Notwithstanding the superabundance of first-class elementary systems of chemistry, like Graham's and Miller's in England, Payen's and others in French, for example, every professor must needs have his own little say by writing his own "elements;" and no matter how bad or useless, because mere copy and repetition, this may be, every one who attends his lectures must needs buy the book, or be viewed, not only as an obtrusive outsider, but sometimes, by the affectation of a strange and peculiar and worse than useless nomenclature, rendered incapable of understanding the lecturer, unless he gets the key to his jargon by buying his book. Those who have known anything of the history of chemical literature for the last thirty years will admit that if this extreme be not often reached, the approaches to it have been many and various; and the fact must be repulsive to the body of chemical professors, which numbers everywhere so many brilliant and honourable men in its ranks.

Our author here is not a professor, but a doer. Scientifically educated in Trinity College, Dublin, and after some experience in other parts of Ireland, he has for some years occupied the responsible position, as a practical engineer, of being charged with the conduct of the engineering works of the port of Dublin, formerly held by the late Mr. George Halpin, a self-taught and able man, and by his son of the same name after him.

In the intervals of professional labour, Mr. Stoney has occupied his mind and time in the production of this treatise on the theory of strains, and by its publication has beyond question bestowed a valuable and important gift on engineers and all engaged in the construction of large iron structures. It is, perhaps, not precisely the sort of work that should at the present hour be placed in the advanced engineering student's hands, as that which is to indoctrinate him with those fundamental theorems, as to the stress and strains of solids, which are to mould his methods of investigation for after life; but it is a work that every engineering student should be acquainted with, and one which, however great may be his attainments, he will find good for that which its author, as indeed he states in his preface, intended to be the main use of his work, viz. "*A Handbook on the Theory of Strains and the Strength of Materials.*" We say this, because the method of treatment pursued by the author, all through the work, consists in applications of the laws of statics and of resolved forces, and does not attempt that which is based upon the deformation of parts and of structures built up of solids, whose properties are defined in the hypothesis, which is the method of Navier, of Bresse, of Caligny, and of all the latest school of continental authors on the stress and resistance of materials; nor, so far as we are aware, has he introduced the fertile principle of *résistance vive*, which, with the above method together, are sure to evolve such important and remarkable results in applications to practice within the next few years.

However, in view of the average mathematical attainments of the present generation of engineers in Great Britain, and of the absence as yet of any general teaching, or of any elementary books in English in which "the method of deformations" is taught as the groundwork for the theory of stress and strain, we think the author has probably exercised a sound discretion in adopting methods more readily intelligible to all, and more likely, therefore, to be employed by and be useful to practicians only.

Whilst it can scarcely be said that this work contains any absolutely original investigation, i.e. the investigation by new methods of old problems, or that of questions never before examined fundamentally, it may quite truly be said that the work consists of a connected train of original investigations from beginning to end. And this is really its great peculiarity and merit as an English work; it begins with the simplest cases of transverse strains, and with a uniform notation follows on until it has taken us through the most complicated cases likely to be found in practice of braced girders, compound bracing, curved webbed girders, continuous girders, and so forth; direct pressure, as in pillars &c. being treated of as appertaining to struts in such cases. Now this will not be found in a separate, and yet systematic form to the same extent, in any other English work that we are acquainted with, not at any rate at once in anything like the same extended scale and useable form.

In the first volume, after a brief introduction, we are taken through all the cases of simple semigirders (or cantilevers) and girders transversely loaded in various ways, with the webs doing no duty but that of uniting the top and bottom flanges, i.e. bearing shear only, and with the webs bearing a more or less important part in the transverse resistance in addition to that of the flanges. Then we pass through the principles and forms of bracing and to open-webbed or braced girders, repeating with these all the conditions of girder and forms of loading, and so on to continuous girders, with which the volume ends, deflection having been treated as we went along, as well as ultimate resistance.

The second and larger volume opens with the 13th chapter, in which compression and pillars are treated of. From this chapter —and we may indeed partly include some of it—to the end of chapter 26 inclusive, the matter of this volume may be viewed as in a great degree treating of the physical properties of constructional solids when applied in various ways, with, however, more or less of the mechanics of stress and strain running along with that. With so vast a mass of subjects as this pressing here for consideration, it is not to be wondered at that the treatment of a good many is far from exhaustive or even complete. In fact, we are obliged to confess to having formed a less favourable judgment of this than of the preceding volume. As we presume there can be but little doubt that the practical merits of the work will sustain the call for new editions, we may be excusable in pointing out a few things that seem to us may be at least improved or, as omissions, supplied hereafter.

The only investigation, the only formulæ given for the resistance of long columns, are those of Hodgskinson, valuable no doubt, but often troublesome to use. The earlier formulæ arrived at by the illustrious Euler were underrated—not to use the harder term—by Hodgskinson; yet those formulæ really give results pretty nearly as trustworthy as his own, and are those largely in use amongst German engineers to the present hour. Without the tables given by Hodgskinson, and which are even themselves quite too restricted for the occasional demands of practice, his formulæ are of very little use.

What we chiefly find fault with, however, is that a gentleman of the clear thought and good scientific education of the author should have to so great a degree followed the beaten track of the English school of mere compilers, and passed into his pages, without assimilation or digestion, so much of the crude stuff that English experimenters have within the last half century poured forth. Thus Mr. Fairbairn's untenable conclusion, that because he found a particular cast-iron, after repeated meltings, had its maximum of strength, *when cast into one-inch square bars*, at just the *thirteenth* melting, and that *therefore all other cast-irons*, or *all other sizes* of bars cast from them, will be strongest just at the *thirteenth* melting,—is given without note or comment; yet it is neither true, nor follows from the premises. It would be easy to produce samples of cast-iron that, in place of being improved at all, must be deteriorated by the first and by every subsequent melting.

Fairbairn and Tate's experiments on the tensile and crushing resistances of glass are briefly given; and without any question their almost certainly erroneous conclusion is also given, that the much greater tensile strength deduced from the bursting of thin glass globes by water pressure, than that shown by direct pull upon glass rods, is "*no doubt* mainly due to the fact that thin plates of this material generally possess a higher tenacity than stout bars, which, under the most favourable circumstances, *may be* but imperfectly annealed." Furthermore, according to these experi-

menters, the crushing resistance of glass is *twelve times* its tensile resistance.

Now if the former proposition were true, and always so, how could want of annealing account for the anomaly? All that want of annealing can do is to make the glass brittle, but certainly not to diminish its ultimate resistance to pulling asunder, without perhaps any sensible extension. The truth no doubt is, that the experiments themselves are inaccurate, arising from the excessive rigidity of glass, and hence the immense difficulty of bringing the line of pull exactly into the axis of the rod pulled asunder; and this divergence will be least when the glass is in the thinnest strip, and will almost disappear when the tension is produced by water pressure upon the inside of a thin globe of glass. This is also the key to the (as we believe) wholly unreliable statement that glass possesses a property, *sui generis*, not shared by any other substance whose properties are known—viz. that its crushing resistance is *twelve* times its tensile one. A short piece of glass can be crushed nearly coaxially, but it is never certain that it is pulled asunder so. We believe, indeed, that there is good conjectural ground for deeming this difference to be overstated at least threefold. It may be said, and truly, that to the practical engineer the properties of glass are of little importance; but our notion of text-books is, either leave out all doubtful data, or, if they be stated, supply the *granum salis* with which they are to be accepted.

Amongst some very good remarks upon "permanent set," "recovery," and the "action of time" &c., we find here and there some that seem to us more than doubtful.

At p. 301 twelve tons per inch is said to be about the elastic limit of wrought-iron—to static strain, of course; beyond this it stretches, and though "this may not in the least diminish its ultimate strength, it thus may render iron which was originally tough and ductile so hard and brittle as to be seriously injured for many purposes."

Now for this, we confess, we think there is no authority whatever; if the iron be originally tough, it *may* be less tough after stretching to twelve tons, but no amount of slow stretching will convert it into brittle iron. Mr. Stoney is, no doubt, aware that the practice of some of the best makers of suspension bridges in the world has been to stretch every link until the length between the eyes is the same.

In the article (p. 418) on the effects of change of temperature on iron, we have the usual class-book statements that a change of temperature of 8° Cent. may be equivalent to a strain of a ton to the inch in wrought-iron; but we should have expected, when the *red*-hot bars of the Conservatoires des Arts et Metiers are in the same paragraph referred to, that something should have been said as to the effects of such high temperature on this strain, which may be very far indeed from equal to the ton to the square inch every per 8° Cent. of the whole range.

Passing on to the effects of wind upon structures, we have Smeaton's old table for the ten thousandth time reproduced, but we look in vain for any real guide to the practical engineer of the effect of side-wind upon his long or lofty iron structures. Yet this is at this moment just the moot point as to the margin of stability of iron viaducts, such as those of M. Nordling on the Paris and Lyons branch railways. We may add that the effect of the wind on such structures is certainly *not* that of a force uniformly distributed, nor capable of being estimated in any way but dynamically, and that the real point in reserve and needing elucidation before we are in a position to determine anything about the matter, is to discover what is the *effective* resistance to the wind of perforated surfaces, such as the web of a lattice girder, and what ratio, given the solid and the perforated surfaces, per total unit of exposed area does this bear to the effect of the same wind upon a completely filled-in and similarly placed and exposed surface.

The treatment of the question of the effect of rapidly rolling loads upon girders having a sensible curve of deflection, is very incomplete and unsatisfactory at p. 347. An extremely simple method of approximate treatment of this question, which Professor Willis wrapped up in such a useless haze of transcendental mathematics, has been given by Morin, and certainly should have been quoted at length, for this source of increased stress is not negligible in many cases.

As we have unwillingly had to find fault with parts of this second volume, we shall only add in respect to what is given as to the effects of long continued deflection &c. upon iron (p. 375 &c.), that a recent discussion at the Institution of Civil Engineers, London, has put in a clear light the shortcomings, indeed the perfect mess, that our "accepted-without-questions-asked" knowledge of this branch of the subject of the strength of materials is still in. "Punching," we are told (p. 389), "reduces the tensile strength of steel plates one-third as compared with drilling"—on authority of the naval architects; now this is one of those thoroughly deceptive, "slick" statements made by half-informed or illogical experimenters, that we must say we should have expected an author of Mr. Stoney's calibre to have kept clear of, i.e. duly "ear-marked." Might not a steel plate lose *all* its tensile strength by punching, and will not what proportion it does lose, depend not only upon the mode of punching and its velocity, and upon *where* in the plate the hole is punched, but also on the quality of the steel, which may be as rigid as glass nearly, or almost as soft and tough as an iron plate?

More might be said in this view were we to go through the volume; we regret that, to be honest, we have had to say thus much.

As it appears to us, the author has tried to comprise too much in his second volume, and has not been by any means as full and complete in his physical portions as in those merely mechanical. Notwithstanding this, we repeat the praise of the work generally with which we commenced, and hope to see future generations of it, in new editions, widely diffused.

With such in prospect, we would offer a friendly suggestion to Mr. Stoney to modify the symbols of his notation in some respects, and to copy those methods as to symbolisation which have made amongst the French a notation really national, and characterised by its mnemonic advantages, simplicity, and beauty. Such an expression as—

$$M=\frac{2bf}{c}\int_{\delta}^{\frac{d}{2}} y\,dy=\frac{bd^2f}{12c}$$

in which the same $d$, in the very same type, means the differential of $y$ and also the depth of the girder, is scarcely excusable in a work intended for reference by men whose time is too much pressed upon to admit of their painfully following back to distinguish these $d$'s, even although, as here, the statement be made parenthetically that one of these two Dromios means a differential.

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*On Aniline and its Derivatives: a Treatise upon the Manufacture of Aniline and Aniline Colours.* By M. Reimann, Ph.D. &c. Edited by W. Crookes, F.R.S. Longmans, London, 1868.

This is one of the several translations of important foreign works, treating of applied chemistry, with which Mr. Crookes has enriched our technological literature.

Dr. Reimann's work starts with the origin of its subject from benzole, with which he gives a sketch of the products of decomposition by distillation of coal; and then he follows on through nitro-benzole and aniline to the now, we may really say innumerable, colours or dyes obtainable from that, and the practice to be employed by the dyer in the use of each; finally treating also of the dyes derived from the naphthaline series. The treatment is throughout that of a thoroughly clear, terse, and practically applicable book.

Whilst in the press, the fine joint Report of Dr. Hoffman and MM. de Laire and Girard, on the colouring matters derived from coal-tar, as exhibited at Paris in 1867, appeared; and this has been judiciously superadded to the text. Of its value, theoretic and practical, its authors' names are a sufficient guarantee.

The progress of the applied chemistry of these coal colours is so rapid, that even already a considerable number have been added to the list known but a year ago. From that marvellous substance, *anthracene*, for example, has been produced artificial garancine, a product that in the end will probably put an end to the cultivation of natural madder, and revolutionise one staple of the agriculture of Southern Europe. There will, therefore, be ample room and a powerful call for a new edition of this excellent volume, which is probably ere now nearly out of print.

## CORRESPONDENCE.

☞ We do not hold ourselves responsible for the views or statements of Correspondents.

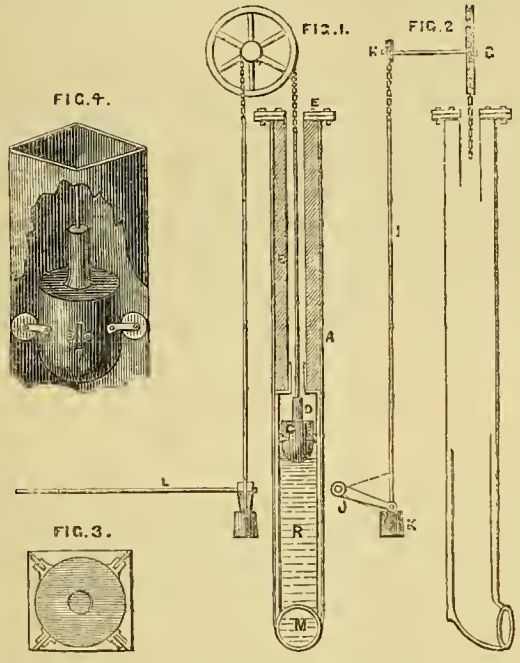
TO THE EDITOR OF THE PRACTICAL MECHANIC'S JOURNAL.

Prestonpans, 13th December 1869.

SIR,—I have here enclosed a plan of the float which I referred to in my last communication. There are many ways of carrying out its connections in detail, but what I have given will, I think, be enough to show how it can be applied, and experience would suggest improvements.

I saw difficulties which are inseparably connected with this principle from the first, but, for the reasons formerly given, I venture to bring it before you, that whatever discussions may take place upon marine governors, it might stand investigation.

The plan I have already sent for a governor is, I think, the best of the two, and if made perfectly air-tight, can scarcely go wrong. I omitted to mention (though you would see by the sketch) that the bottom part of the tube requires to be straight, and not bent like this one for the float, and the entrance equal in size to the rest of it, so that the air will be compressed at the same rate as the wave rises, and lessen at the same rate as it goes down.




The following is the description of the "float":— Let A represent a square tube, built as part of the ship, and B another square tube fitted into it for the float to work in, the length of which to be the diameter of the screw, with the length of the "float" in addition. C the float made of cork wood, covered with india rubber, to keep it properly together, and guided by four small wheels, as shown in figs. 3 and 4, which will facilitate its rising and falling on account of the different positions the tube will be in when the ship is pitching and rolling; D is a neck-piece upon the float, which may be about a foot long, to plug up the aperture at the top of B, so that the air may be compressed to keep down the wave from driving the float with violence against the top of the tube, and fitted in such manner that it will work freely without sticking, as the compressed air will have to make its escape up the sides of it to let the float rise the full height; EE two pieces of wood screwed down by the cover F to keep B in its place. By taking off the cover F, the float and tube can be drawn out at any time and examined. Suppose the diameter of the screw to be six feet, the float to rise and fall the same distance, the wheel G to be two feet, and H six inches in diameter, both above deck, the wheel H to be incased to prevent water getting down into the hold when the waves break upon deck. The six-feet travel of the float will give the wheels one revolution; suppose the weight of the float to be 10 lbs., to balance it would require the weight K, hanging from wheel H, to be 40 lbs.; by making it twenty gives the working power of the float to be 5 lbs. either way, which, with its leverage of six-feet travel, will be enough to work a pretty large throttle valve.

The weight K to be rested when the float touches the top of the tube. The crank J fixed upon the rocking shaft L, worked by the rod J; L carried along the side of the screw shaft to the engine-room, which can be adjusted with a crank to suit the required travel of the throttle valve; M is the entrance of the tube from the side of the ship, and might be made from both sides.

Fig. 4 represents the float on a larger scale.

Trusting this explanation will be sufficient to be understood,

I remain, Sir,

Yours most respectfully,

GEORGE PRINGLE.

166 Buchanan Street,
Glasgow.

## PROCEEDINGS OF SCIENTIFIC SOCIETIES.

### THE INSTITUTION OF CIVIL ENGINEERS.

The annual general meeting of this institution was held on the 21st December last, Charles Hutton Gregory, Esq., President, in the chair.

In reviewing the events of the past twelve months, completing the fifty-second year since the foundation of the institution, the Council stated that the proceedings had furnished corroborative evidence of the sound basis on which the society was established—a basis which had been taken as the model for many analogous institutions, both at home and abroad.

The originality, labour, and ingenuity displayed in the papers read at the ordinary meeting (of which there had been twenty-two) during the past session, had led to the award of Telford medals and Telford premiums of books to Messrs. Jules Gaudard, W. Shelford, T. N. Kirkham, J. Ellacott, and D. T. Ansted, F.R.S.; of a Watt medal and a Telford premium of books to Mr. Z. Colburn; of Telford premiums of books to Messrs. W. H. Wheeler, J. R. Mosse, I. Bell, J. Milroy, S. P. Bidder, jun., and C. J. Chubb; and of the Manby premium of books to Mr. D. M. Henderson.

In addition to the ordinary general meetings, there were six supplemental meetings, for the reading and discussion of papers by the students. In consequence of the students having failed to supply further papers, the Council were not able to extend the number of these meetings. This they regretted, being persuaded that such meetings and the due preparations for them could not fail to be productive of the greatest possible advantage. For the papers read at these supplemental meetings, Miller prizes had been awarded to the following students: Messrs. E. Bazalgette, F. H. Mort, T. J. Ellis, T. R. Gainsford, C. H. G. Jenkinson, and G. H. Roberts.

It was stated that during the past year upwards of seven hundred volumes and pamphlets had been added, either by presentation or by purchase, to the library, which now contained about five thousand eight hundred volumes, and four thousand three hundred tracts, on every branch of civil engineering, and in many different languages. A portrait of Mr. Fowler (past-president), painted by Mr. J. E. Millais, R.A., had also been received, and from Mr. M'Clean, M.P. (past-president), seventy-two engraved copper plates, which had been used to illustrate an early edition of Smeaton's Reports.

During the last session 30 members and 82 associates had been elected; but as the deceases, resignations, and erasures from the register were double what they had been in any previous year, the actual increase in the gross total of the several classes composing the corporation was only 42, or 2·7 per cent. on the present number. There were on the books on the 30th of November 148 students, as against 133 at the same date last year. If the students were included in the enumeration, as the graduates used formerly to be, it would be found that the gross number of all classes now on the list was more than double what it was twelve years ago—1,739 as against 857. The actual numbers of the four classes—honorary members, members, associates, and students—were 16, 655, 920, and 148 respectively.

The deceases announced since the last annual meeting had been nearly 16 in the thousand on the present number of members belonging to the corporation.

The ordinary receipts for the past year had amounted to 7,032*l.*, being only 141*l.* less than they were in 1868, notwithstanding the loss of dividends due to the sale of stocks necessary to meet the expenses of the new building. The expenditure in the same period (exclusive of the new building) had been 3,786*l.* During the financial year ending on the 30th of November last, a sum of 8,498*l.* 5*s.* 6*d.* was paid on account of the new building and its accessories, making, with the sum of 9,711*l.* 16*s.* 10*d.* expended up to the date of the previous annual meeting, a total outlay of 18,210*l.* 2*s.* 4*d.* This outlay had been entirely defrayed out of the funds of the institution.

The Council had recently taken vigorous measures to vindicate the honour of the profession, which had been unjustifiably assailed by the Government of India, in a notification the plain intention of which could only be, to charge civil engineers with recognising as legitimate the receipt of commissions from others than their immediate employers, and in addition to their salaries, where so remunerated. The Secretary of State for India had put on record "that he regards with implicit confidence the indignant repudiation by the Institution of the recognition of any such practice as that referred to," and that he would call upon the Governor-General in Council for an explanation of the circumstances which led to the issue of the objectionable notification. A sufficient time had not yet elapsed for an answer to be received from India to the remonstrance of the Institution. In the meantime the Council felt assured that the steps they had taken would meet with cordial approval.

The following gentlemen were elected to fill the several offices on the Council for the ensuing year:—Charles Blacker Vignoles, President; Joseph Cubitt, Thomas Elliot Harrison, Thomas Hawksley, and George Willoughby Hemans, Vice-Presidents; James Abernethy, William Henry Barlow, John Frederic Bateman, Joseph William Bazalgette, Nathaniel Beardmore, Frederick Joseph Bramwell, James Brunlees, John Murray, George Robert Stephenson, and Edward Woods, Members; and Edward Middleton Barry, and Lieut.-Colonel Andrew Clarke, C.B., R.E., Associates.

### LONDON ASSOCIATION OF FOREMEN ENGINEERS.

The eighteenth annual general meeting of the members of this institution was held on Saturday, the 1st ult., at the City Terminus Hotel. The chair was occupied by Mr. Joseph Newton (Royal Mint); the attendance was good. After the routine business and nomination of new members, the auditors produced the

balance-sheet and financial report. The total number of ordinary members is 108, and that of honorary members 61—total, 169. The ordinary fund for meeting the working expenses of the society amounts to £459 13s. 11d.; the superannuation fund, the interest alone of which is used for the solace of decayed foremen, is equal to £1,016 17s. 4d.; and the widows' and orphans' fund stands at £15 4s. These items make a grand total of sums invested for all purposes equal in value to £1,479 15s. 3d.; and this exhibits a net increase during the twelve months of £146 14s. 4d. The balance-sheet was, with the auditors' report, unanimously accepted.

The chairman next delivered the annual address. This comprised a retrospective and comprehensive view of the history and progress of the institution during the past ten years. One of the most gratifying facts in regard to the present position of the association was (Mr. Newton said) the steadily increasing friendship towards it of the employers of engineering labour throughout the kingdom. Ten years since not a single employer's name graced its books; now more than twenty of the most eminent of those gentlemen were enrolled as honorary members, and were liberal contributors to its benevolent funds. Many distinguished scientific men, apart from the engineering community, were also connected with the society, and assisted in promoting its charitable objects. Altogether, he (the chairman) considered that the Associated Foremen had real grounds for satisfaction. Still, more remained to be done. Was there any valid reason, for example, why young workmen who were desirous of advancing themselves in technical and practical knowledge should not be permitted to unite themselves as students, or otherwise, to the association? By such an arrangement the embryo talent of apprentices and assistants would be more speedily developed, and advantage would accrue to the entire engineering community. Employers would probably favour the scheme because they would benefit by the increased intelligence and usefulness of their young employés. Foremen would not fail to derive advantages from it, because the teachings of the lecture room would produce their fruits in the workshop and conduce to a more intelligent realisation of their own orders and instructions. The pupils themselves would have a direct interest in the successful working of the plan, for they would reap immediate good from the lessons of experienced mentors; in short, the whole profession would find its interests advanced by the extension of the educational influences of the association. Independent societies of a similar kind to their own had grown into vigorous existence at Manchester, Leeds, and Middlesborough, and were in process of formation at Glasgow, Ferryhill, and Birkenhead. At all these places employers were co-operating, more or less, with their foremen in supporting or founding these associations.

It has been announced that Sir William Fairbairn, LL.D., will preside at the anniversary dinner of the association, to be given at the City Terminus Hotel, Cannon Street, on the 19th inst.

## MANCHESTER INSTITUTION OF ENGINEERS.

On Tuesday the 4th ultimo, a meeting of the Manchester Institution of Engineers was held in the Mayor's Parlour, at the Manchester Town Hall, to hear a paper read by Mr. T. Aston, barrister at law, of Lincoln's Inn, on the subject of the Patent Laws. Mr. Platt, M.P., presided.

Mr. Aston said the subject naturally divided itself into three branches—first, the policy of granting letters patent for inventions; secondly, the working of the existing system; and thirdly, the amendments which appear to be needed. He thought the objections to letters patent were partly based on results attributable not to the legitimate use but to grave abuses of the patent laws, and partly on the mistaken supposition that those abuses were inherent in the system and without remedy; whereas he contended that they were, in fact, capable of being remedied by amending the existing laws. After defending, at some length, the right of property by an inventor in his own invention, Mr. Aston proceeded to discuss the objection urged against the system in the House of Commons by Mr. Macfie, M.P. for Leith, in the last session, viz., that patents were opposed to the principle of free trade. If this were the fact, he said it would not be easy to answer this objection to patents. But he contended that the patent law, by recognising property in invention, and making it negotiable in the form of a patent which could be freely bought and sold, did not obstruct, but promoted, free trade in inventions. By abolishing the patent law, they would not only prevent free trade, but all trade in inventions; for where there was no property there clearly could be no trade. The doctrine that the law should not recognise a man's property in a new and undisclosed invention, but should drive him to surrender it as a forced contribution to the common stock of mankind—such a doctrine was clearly no doctrine of free trade, which never could make it lawful for any man or body of men to appropriate the fruits of another man's labour without giving payment in fair barter. Such a doctrine would confound the free trader with the freebooter. It was an abuse of the present system that grants of patents were not confined to real inventions, but were indiscriminately granted to false, pretending, or what might be termed pseudo inventions. This was an abuse which ought to be, and, he believed, might be, easily remedied. At present there was a clause which provided "that if, at any time during the term hereby granted, it shall be made apparent to any six or more of the Privy Council that this grant is contrary to law or prejudicial or inconvenient to our subjects, these letters patent shall forthwith cease and determine." This was, however, so cumbrous a remedy that he had never heard of its being resorted to. Why should not a like power of avoidance be given at an earlier stage and be conducted by a tribunal more easily approached than the Privy Council? He proposed the amendment of the law so as to limit the grant of a patent to applications for what on proper examination might properly claim to be real and useful inventions. Assuming, then, that they were dealing with those patents which were granted for what were properly called inventions, he contended that a reference to the Patent Office would show that it induced the discoverers of inventions to add them to the common stock of mankind. There was not a single important improvement applied to the industrial arts which had been made in our times that had not been the subject of a patent grant, and of which therefore the public had got immediate possession, as soon as each grant had been made, through the inventor's own description deposited in the Patent Office. On an average about 2,500 of those descriptions given in the complete specifications of as many new patents granted were deposited in the Patent Office every year, and among them, beyond question, were many of great value, and all were accessible to every one of the public who desired to make use of them. In no other way that he could conceive of could the public obtain the benefit of the long labours, research, and ingenuity of inventors. It must, as already stated, be admitted that in some cases the public, or a portion of the public, suffers from evils caused by certain defects in our existing system, so it cannot be denied that other causes prevent the inventor in this country too often from enjoying a proper legal recognition of his property, and so reaping a due reward for his exertions. This latter result, after much reflection on the subject, he attributed in a very large measure to a radical defect in the mode in which, under the present system, the bargain is made between the inventor and the State on behalf of the public. That bargain is made in the following way: An inventor applies by petition to the Queen for a patent, and with his petition he sends a written description called a provisional specification, which ought to describe generally the nature of his invention, but is not required to define the limits or boundaries of the invention claimed. Thereupon the application for the patent is referred to one of the law officers of the Crown; and if he approve of it the patent is usually granted in due course. But granted for what? At the time of the grant it is not known what it is for, but actually it is a grant for whatever the grantee chooses to make it by his own description, called his complete specification, drawn in his own way, without any official examination, and deposited in the Patent Office at some period after the grant is made. He had no hesitation in stating it as his opinion, founded upon long experience, that to this radical defect in the existing system the greater part of the existing abuses may be attributed. It is a defect that causes injury both to the public and the patentee, for it must not be thought that the apparently one-sided concession made to a patentee, and enabling him to fix his own limits to the invention he proposes to claim, is any advantage to him; on the contrary, it is too often a delusion and a snare. By an express provision in his patent it is made absolutely void, unless the patentee within a fixed period files a complete specification, which must be one that will be held to be sufficient in law, and in which he is left to give his own description, and make his own claims at his own peril. But what is the meaning of sufficient in law? That the patentee will not, under the present system, be able to find out until it may happen, unfortunately for him, that he has to take his patent into a court of law. Then the sufficiency of his specification in law, and the consequent validity of his patent, will depend upon the opinions formed by the judges sitting in the court in which the case may happen to be heard. The specification will then, for the first time, be officially scrutinised. The scrutiny will be a rigid one, and often of a character not expected by the patentee, for the invention may relate to a subject of which the scrutinising judges may have had no previous acquaintance; but if their minds be not satisfied, from the point of view they may take of the invention, that the description and claims are sufficiently precise and clear, the patent is gone. This is the principal reason why, unfortunately for patentees, many patents for most meritorious inventions fail when brought into court, or cannot safely be taken there, and in that way many deserving patentees are prevented from establishing their just rights. This might be avoided by a simple remedy in the existing law, that is by officially examining the specification of an invention before a patent is granted, and by enabling the patentee to know, at the outset, if it is sufficient or not. That simple remedy would not only be a boon to the patentee, but would be no less beneficial to the public. By granting, as under the present system, a patent for unknown claims, and that without any official supervision or examination, it has resulted that most confused, or one may say elastic, claims can be made by a patentee, so as to prevent the public from being able to ascertain with any certainty what is intended to be claimed under his patent. Why should it, by such a haphazard legislation, be made possible for a patentee to put one construction on his claim to-day and another to-morrow? This was an abuse as easy of remedy as it was grievous for the mischief it had brought about. The practical working of the present system was that all the provisional specifications of patents applied for, being in number 4,000 in every year, were referred for examination to the two law officers for England. The advantage of bringing to bear upon the inquiry in question the legal experience and skill of men of such proved knowledge as her Majesty's law officers, is no doubt a great advantage, but he contended that it would be sufficient to do this in exceptional or appeal cases. At all events, considering what are the other duties of her Majesty's law officers, they ought to be relieved of what he could not help calling the drudgery of examining 4,000 specifications every year. There would be no difficulty in amending the law so as to provide for the necessary examination being conducted with proper efficiency by specially appointed examiners (hear). There was yet another case in which the existing system was administered under difficulties so trying that it confessedly often breaks down. He alluded to the conditions under which actions or suits relating to patents are frequently tried. The judge whose duty it may happen to be to try the case most likely finds it to be one put down in a long cause list, containing scores of cases to be got through, perhaps, in as many hours, and of course a judge takes a judge-like pride in getting through his cause list. He sees on his list a patent case, and he sees the court filled with strange and complex models or machinery, new to him, and often a magical mystery to the twelve intelligent jurymen—(laughter)—who are to give their verdict upon issues which they very often could never be made to understand. Is it to be wondered at that under such circumstances a judge, however high might be his resolve to discharge his duties at any self-sacrifice, should view with disfavour a case, or class of cases, one of which alone usually takes up as much of his limited time as he may calculate upon giving perhaps to twenty? Was it to be wondered at that counsel, under such circumstances, should feel oppressed with the knowledge that an important case cannot be properly investigated? Lastly, was it to be wondered at that a patentee will often shrink from going through so precarious an ordeal as a trial to establish his rights, or that an alleged infringer will often submit to a charge he believes is unfounded rather than face it under such difficulties? Patent

cases are in their nature as technical, and very often far more intricate than Admiralty cases, and yet they are tried under like conditions with a common action to recover a trade debt. He did not say it is necessary to establish a special tribunal for trying patent causes, though he believed the system works well in relation to Admiralty cases. He thought a simpler remedy may be found for existing difficulties, and he also thought that the judges who now so worthily fill the seats of justice in our courts are well able to grapple with the toughest patent case that could be brought into court. But, beyond question, patent cases would be more satisfactorily dealt with if they were appointed to be tried at special sittings, and if the presiding judge were assisted by skilled assessors (analogous to those who assist in the Admiralty Courts), who could supply the technical information that might be needed by the judge. Mr. Aston concluded by urging that the remedies he recommended were not remedies which were speculative or based on any individual theories. He observed: Many of them have been tried, and those to which I attach the most importance have been fully tried in the United States of America, and found to work well. I mean the exercise of discrimination in the grant of patents, and, what is still more important, the deposit, before the patent is granted, of a precise description of the invention and claims, given in a complete specification, which is submitted to a proper official examination before it is passed as sufficient. My own opinions upon the working of the American patent laws are founded upon a personal investigation of the system adopted in the United States, and from continued experience gathered in professional practice. My conviction is that the American system, though it has its imperfections, does work better than ours, and that because it has cured in a great measure the chief defects under which our system is still labouring (hear, hear). That our defective laws should have produced abuses is no marvel, but a natural consequence, especially, as I said before, when those laws have not been fairly tried. But while those abuses are made very conspicuous—not only by their own prominence, but by the severe, and in many respects deserved, comments of those who found upon them their attacks against the patent system—let it be remembered that it is the dark side of the system which is thus brought into public notice, where legal proceedings are made oppressive upon alleged infringers, or where meritorious inventors fail in obtaining their just rights. It is only fair, on the other side, to take notice of the quiet stream of licences and assignments which runs smoothly through the Patent Office year by year. In 1866 the number of licences and assignments of patents registered in the Patent Office was 596; in 1867, 606; in 1868, 653, in 1869, 675. From my professional experience I am justified in saying that a large number of those registrations are records of prosperous trading in inventions beneficial alike to the inventor and the public user. When I add that for some of those registered transfers the consideration has varied from 80,000*l.* to over 100,000*l.*, the importance of the existing trade in inventions cannot fail to be recognised. And yet this is the trade, itself the parent of so many trades, that would be absolutely destroyed if patents were abolished, by which alone the law can recognise the property on which the trade is founded. I ask whether it is not sound sense and sound justice to give the patent system a fair trial, with its defects remedied, before a blow, possibly fatal, as all admit, and necessarily fatal, as many of our great thinkers believe, be given to our industrial prosperity, by destroying the patent system, with which it is so intimately connected, and on which it has been so successfully built up (cheers).

Sir Wm. Fairbairn said he had listened with the greatest attention to the excellent paper which had just been read, and was certain that all present would agree in the general principles which Mr. Aston had laid down. He trusted that those principles would be carried into effect next session of Parliament.

Mr. Henry Ashworth, Mr. Hick, M.P., and Mr. Hibbert, M.P., at the request of the chairman, addressed a few remarks to the meeting, expressing general approval of the principles set forth in Mr. Aston's paper.

Mr. Alderman Curtis moved, "That this meeting considers that the trade in inventions, which is founded upon the granting of patents, is of great advantage to the country in promoting its industrial prosperity, and that any abuses which exist in the present patent system may be rectified by available amendments."

Mr. Henry Ashworth seconded the resolution, which was also supported by Mr. W. Lloyd Wise.

After some remarks from Dr. Pankhurst, concurring with the views expressed by Mr. Aston, the resolution was put to the meeting and passed.

Votes of thanks were also passed to Mr. Aston for his paper, and to Mr. Platt for presiding.

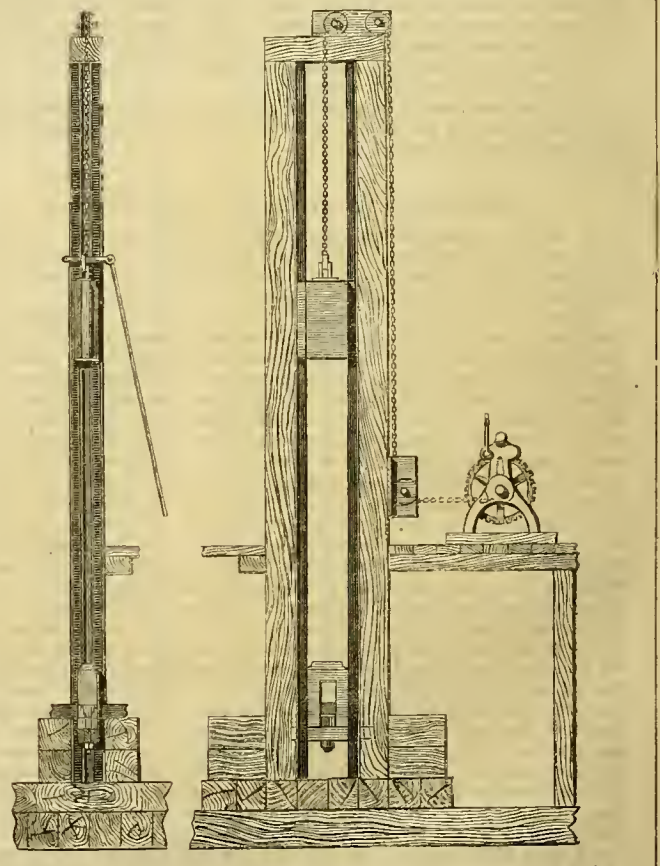
## INSTITUTION OF ENGINEERS IN SCOTLAND.

The president of this Institution, Professor W. J. Macquorn Rankine, C.E., LL.D., F.R.SS.L. and E., F.R.SS.A., &c., in his introductory remarks at the opening meeting of the present session of the Institution, in the course of some observations on patents for inventions, said:—"The efforts which from time to time have been made to procure the abolition of patents for inventions have of late been renewed with much vigour and ability, and, with equal vigour and ability, resisted. The arguments on both sides are well known, and there is only one of them of which I shall remind the Institution on the present occasion; because it is one which, though brought forward some years ago, has latterly been somewhat overlooked. It is this: those who object to the recognition of property in ideas must, in order to be consistent, virtually object much more strongly to the recognition of all other kinds of property; for property in ideas is the only property that is absolute, and not founded on legal or social convention. It is possible by law, or by force, to take from a man all material objects which he may claim, and even the labour of his body: the only possession which is absolutely and unconditionally his own, and of which he cannot by any human power be deprived against his will, is the labour of his mind. Its fruits cannot be obtained from him honestly, except for a price satisfactory to him, or as a free gift on his part. Hence, property in the fruits of mental labour is the truly real property, and the foundation of all other kinds of property, and of all forms of value.

"I will also refer to a question of fact as to which it appears to me that the opponents of the granting of patents are mistaken. They allege that the idea of almost every useful invention occurs to several persons nearly at the same time; and that to grant a patent to one of those persons because he happens to be the first to undertake the publication of the invention, is to deprive for a certain number of years the other actual or potential inventors of their fair share of the benefit. But from long-continued observation of the progress of invention I am convinced that, although the general principle of a class of useful inventions may, and very often does occur to many men at once, such is not the case with methods of carrying that principle into effect; but that in almost every instance the methods of practical application which occur to the minds of independent discoverers of the same general principle are varied sufficiently to enable those methods to be considered as separate inventions; so that the granting of a patent for one of them will not injuriously impede the use of the others. I do not remember any instance of alleged identity of independent inventions in method of application, as well as in general principle, in which an inquiry failed to prove, either that the alleged identity did not exist, or that, if it did exist, it was the result of copying. It is well known that a patent is never granted for a general principle, but only for a method of applying a principle to practice."

## MONTHLY NOTES.

Testing Armour-bolts, &c.—The annexed engraving represents the method adopted at Chatham Yard for testing the tensile strength of armour-bolts, and also the holding powers of the heads and nuts under a suddenly applied force. The machine consists of a vertical frame of wood, with grooves formed by angle-irons on the inside, in which a heavy weight moves up and down, the weight being raised by means of a hand-winch, and let go at any height by a slip from which it is hung. The bolt is fixed directly under the centre of the weight, the head being

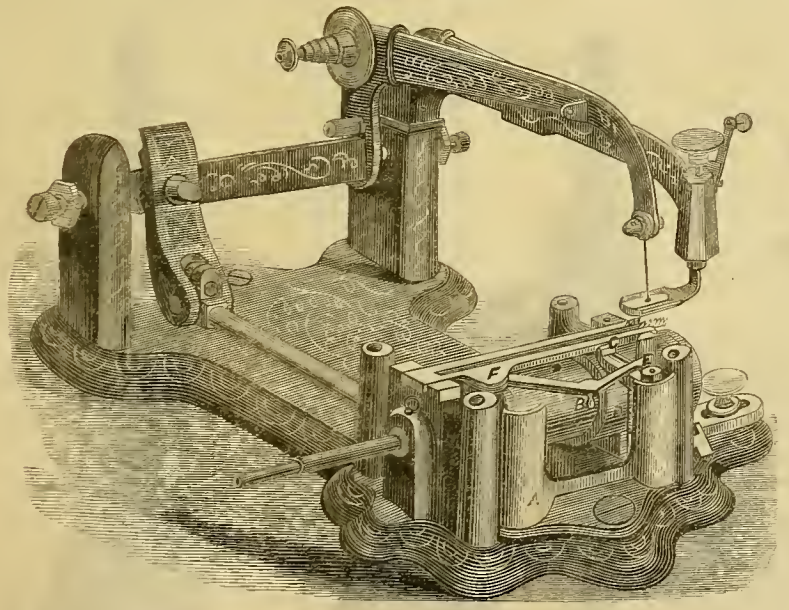


inserted in a piece of armour plate, which is supported at each end by wood bearings. The nut is hove up under an iron block, which is made to pass round the top of the bolt, a slit being taken out of the centre of the block sufficiently large to enclose the bolt and to allow the piece of plate in which the head is secured to pass through. By means of this block the strain caused by the impact of the falling weight is transmitted directly to the under side of the nut, as it would be if a ship's side were struck by projectiles.

The Mines of Cornwall and Devon.—It is calculated that in the six months ended on the 25th of March last, copper, tin, lead, and other minerals were raised in Cornwall and Devon of the value of 637,028*l.*, and in the six months ended the 29th of September, 715,292*l.* In the corresponding periods of 1868 the values were 553,652*l.* and 581,200*l.* The increase shown in the half-year ended September last is in the returns of tin and lead, the production of copper showing a serious decline.

Noiseless Feed Attachment for Sewing Machines.—The device illustrated in the accompanying engraving embraces a novel construction of the "four-motion" feed of a sewing machine, by which a noiseless operation of the feed is secured. The improvement is more especially applicable to the Wheeler & Wilson machine, and is capable either of being attached to those already in use or being embodied in the construction of new machines. The engraving represents the machine with the "plate" removed, in order to show the arrangement of the parts which make up the attachment.

A block or frame-piece A is secured to the frame of the machine by a set-screw passed through a suitable hole or slot provided in the block. At the right-hand end of the block is pivoted, by means of a vertical pivot, an arm C, formed in two parts pressed towards each other by a spring, and so shaped that a slot (the purpose of which will presently be explained) is formed between them. The free end of the arm C is so arranged in relation to the feed-operating cam of the machine as to receive a vibratory movement from the same; the end of the arm being kept in contact with the cam by a spiral spring placed around its pivot, as shown at D. A bent rod E, has one end pivoted, as shown at F, to the feed-bar, while its opposite extremity is furnished with a downwardly projecting pin, which is clasped between the two sections of the arm, C, thereby pivoting such extremity to the rod. The cam above mentioned communicates a vibratory movement to the arm C, and the latter acting through the rod gives the feed-bar its requisite longitudinal motion. The movement of the feed-bar is, of course, proportioned to the distance from the axis of the arm C at which the outer extremity of the rod E is pivoted, as previously explained. This movement, and consequently the length of the feed, may be adjusted or regulated by bringing such extremity to a greater or less distance from the axis, which may be readily done by grasping a small handle (represented in the cut as situated at the bend in the rod). The attachment of the extremity of the rod to the arm C at any point is, it will be noticed, rendered sufficiently firm by the clasping action of the two portions of the arm upon the pin passing between them, as before explained; this same clasping action also preventing a clicking or noise at such point of attachment. It should be mentioned in this connection that the device may be put in place or removed when the machine is in rapid motion. In applying the improvement to a machine of the hitherto usual construction it is only necessary to remove the plate and old feed-bar, and secure the casting A in place by the screw which holds the front of the machine to the table, adjusting the slotted arm C in position, as shown in the engraving, so that it will press against the face of the cam. The feed-bar is laid in place, and the pin put on the end of



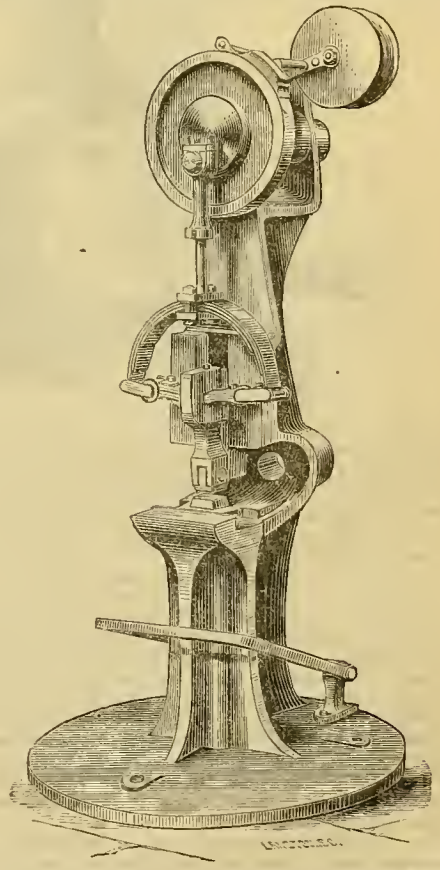
the lever E in the slot of the slotted lever C on replacing the cloth-plate, the machine is ready for use. To shorten the stitch, the handle B is drawn on the lever E outwards; to lengthen the stitch it is pressed in the opposite direction. The casting A also forms a guard to prevent the oil thrown off by the machine from injuring the work or the clothing of the operator. This improved feed attachment is the invention of Mr. C. P. Benedict, of New York.—We have extracted the above from the *American Artisan*.

Aveling's Road Roller.—In addition to the steam road roller which Messrs. Aveling and Porter, of Rochester, recently supplied to the Commissioners of the Central Park, of New York City, and which has given such unqualified satisfaction in its working, the same manufacturers have recently transmitted a second roller for the Prospect Park, Brooklyn, which has been in constant work for about three months night and day. The Commissioners report that it has given great satisfaction, and that for macadam roads, for the rolling of which the machine was adopted, it would be impossible to produce better results. In referring to the economy effected by the roller, the Commissioners' report states that in one day's rolling with Messrs. Aveling and Porter's roller at a cost of $10, as much work can be accomplished as in two days with a 7-ton roller drawn by eight horses, at a cost of $20 a day. Hence the work done by the former is twice as much, and the cost only one quarter that of the latter. Such an opinion made public by a body whose duty would lead them to ascertain exactly the real practical utility of the steam roller, has a special value which will be duly appreciated.

The Perfect Watering-Pot.—Mr. Josiah Le Butt, of Bury St. Edmunds, has recently brought out an exceedingly useful watering-pot, which we illustrate for the benefit of our readers. The ordinary rose is here replaced by a long tube

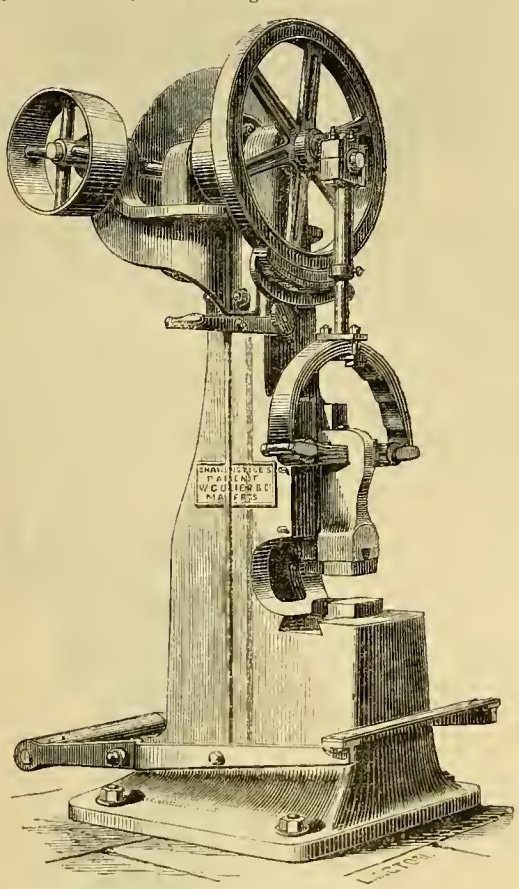
perforated laterally throughout its entire length or the greater portion thereof, whereby facility is afforded for irrigating a considerable breadth of soil at once and for applying the shower well underneath the leaves, the extended perforated pipe being readily thrust under and amongst the plants. We can safely recommend Mr. Le Butt's appropriately named watering-pot to the notice of such of our readers as it may concern.

American Dead-blow Power Hammers.—The principal feature of novelty in these hammers, which are now being extensively manufactured by Messrs. W. Collier and Co., the eminent engineers and machinists of Greengate, Salford, is the intervention of a semicircular spring between the crank pin and the tup, to which the spring is attached by means of a hand or links. The arrangement is clearly shown in the annexed engravings. When the hammer is in motion the tup is



snatched up by the crank pin when passing the bottom centre, and the spring being compressed, the combined action of the spring and crank pin gives the tup great upward impetus, until it is met with the downward action of the crank pin, which causes the tup to fly into the spring (compressing it again), and which throws it down with greater force than can be obtained by any other hammer. When running full speed, the tup traverses about double the throw of the crank, and the weight of the blow is entirely dependent upon the speed at which the hammer is driven. This can be regulated with the greatest nicety either by the treadle or hand motion, and no power whatever is lost, as with other hammers driven by strap, where the force of the blow is regulated by a cushion of air, steam, springs, or other buffers to retard the upward stroke of the tup. The effective force of the blow given is about equal to three times that of a steam hammer in comparison with the weight of the tup; thus, one of 100 lbs. tup will equal a 2½ cwt. steam hammer. The following are stated to be some of the advantages these hammers possess:—They can be fixed in

any desired position where there is a driving shaft, and are quite independent of the position of the boiler, and less power is required for them than for any other hammer. They have very few working parts, most of which are of steel, and not at all liable to get out of order. The bearings are long and bnshed with brass. There are no cylinders, valve rods, or joints, and no packing is required, nor attention after working hours. They are so simple to work and easy to control, that no instructions are necessary, and any boy in the smithy can manage them. They are entirely self-contained, and require but little foundation. They can do anything that a steam hammer can do, and work up to a much higher speed. Tbe blow given is a perfect dead one, and can be regulated from the beaviest "dead blow," to



the lightest touch, or from the quickest to the slowest speed instantly. All these up to 50 lbs. (weight of tup) are made to work by foot only, and from 50 lbs. upwards, by foot or hand lever. The smith can thus regulate either the speed or force of blow while he is forging under the hammer, and no assistance will be required, except when forging long or heavy pieces. The strap is always running, and there is no delay in getting the hammer to work, no water to blow out of the cylinder, and the floor is always kept clean and dry. The anvil and loose hammer in the tup are so constructed that swages, or any other shaped form of dies, may be substitnted.

Freezing and ice-making Machines.—Mr. Franz Windhausen, of the City of Brunswick, Germany, has recently patented some improvements in freezing and ice-making machines of the class in which atmospheric air is compressed, then passed through a condenser, and afterwards expanded again to remove the heat, or, in other words, to produce cold. Such machines have herctofore been limited in their cold-producing properties by the degree of expansion to which the air is subjected, and hy the temperature of the cooling water employed. This invention consists in the construction of a machine of small compass which will, with one constant degree of expansion of the air employed, produce any requisite degree of cold, and which degree of cold can be regulated to the greatest nicety by the hand of the attendant by means of peculiar graduated adjusting mechanism, comprising a three-way cock or valve.

The inventor employs a single double-acting cylinder, or two distinct cylinders, the double-acting cylinder being capable of compressing the air on one side of the piston and of expanding it on the other, whilst when the two cylinders are employed one is used for compressing the air and the other for expanding it afterwards. The air is first admitted into the compressing chamber, and thence passes into a condenser, which forms a material part of the invention. This condenser consists, by preference, of a rectangular chamber, divided into two portions or divisions, having a parallel series of pipes in each division, the nearest of snch pipes to the compressing chamber through which the air first passes being surrounded by cold water, which is constantly running through it in an opposite direction to the current of air, so as to cool the air passing through such pipes, the second series of such pipes through which the air next passes being surrounded by cold air. The air having thus passed through these two series of pipes then enters the expansion chamber, where it is expanded and cooled, and then escapes through a temperature regnlator (acting in the same manner as a three-way cock or valve) into the refrigerator. In this refrigerator the vessels are situated which contain the liquid to be frozen, which may be in the form of pipes, through which the air, gas, or vapour to be cooled may be passed. By means of this temperature regulator a portion of the air proceeding from the expansion chamber may he admitted into the space surrounding the second series of pipes, so as to impart coldness to them ; in fact, when the cold air admitted into the refrigerator has given off its cold, or become heated, it passes through this same space, but enters from another point on its way to the compressing chamber, and may, previously to reaching the compressing chamher, be made to pass through one or more pipes surrounded by the running stream of water, which afterwards passes through the casing containing the first-mentioned series of pipes, and thus may have a cooling effect upon such water. Having thus circulated through the machine, the same air is again admitted into the compressing chamber, and the whole operation is repeated, thus keeping up a complete circulation through the machine. The cylinders are fitted with indnction and eduction valves worked by eccentrics or tappets on the crank shaft, which latter is connected by a connecting rod to the piston in the ordinary manner, so as to be worked either by power or by hand. In order to maintain an equal pressure of air in the refrigerator and condenser a pressure regulator, in the form of a balloon, made of vulcanised india-rubber, or other suitable elastic material, is in communication with the interior of the refrigerator, which regulator stretches out when the pressure in the refrigerator is greater than that of the atmosphere, and is contracted as soon as the pressure in the refrigerator is less than that of the atmosphere. The refrigerator is further provided with a valve, opening inwards, which is acted upon hy the atmosphere, and supplies any loss of air in the machine, the fresh snpply entering by such valve being dried by passing through chloride of lime previous to entering the machine. The inventor sometimes dispenses with the chloride of lime, and takes the atmospheric air into the compressing chamber direct, and leads the cooled air, or part of it, into any space in which a low temperature is required; or he takes the air, by the aid of a pipe, from such space into the compressing chamber, and leads the cooled air or part of it back by another pipe.

Four Ton Single Standard Steam Hammer.—The accompanying engraving is an illustration of a four ton steam hammer recently made and erected by Messrs. Francis Berry and Sons, of Sowerby bridge, Yorkshire, at the works of Messrs. A. Leslie and Co., Hebburn, near Gateshead-on-Tyne. As will be seen by the engraving, the hammer is of the single standard class, and we believe it is the largest that has yet been made of that description. The standard is made of wrought-iron, and is bolted to a massive cast-iron base plate. The cylinder is 28 inches in diameter, and 5 feet stroke, and is bolted between the plates, which are

Fig. 1.

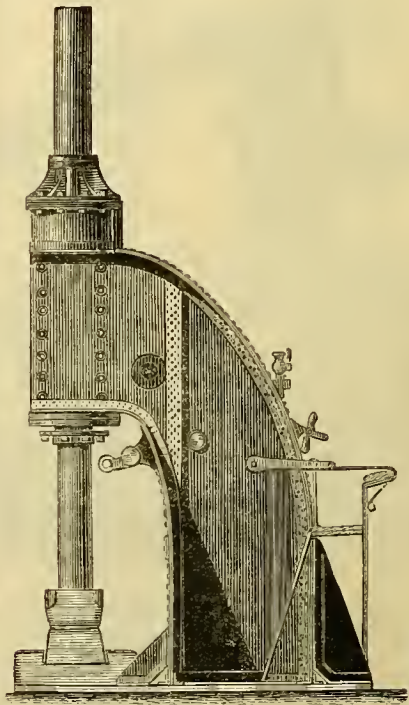
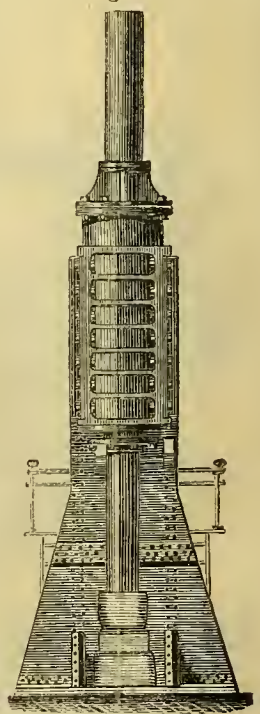


Fig. 2.



made double thickness at this point. On the cylinder is cast a flange at top and bottom, which takes the strain off the bolts. The hammer bar is 13 inches diameter, and is forged in one piece with the piston from the best hammered iron. The great advantages of this hammer are, that it leaves three sides quite open, and heavy or large pieces of work are consequently much more easily handled than with a donble standard hammer, as it can be worked from either side or from the front, and the workmen can see much better what they are doing.

The Issue of Martini-Henry Rifles.—Fifteen of the newly made Martini-Henry rifles for tbe use of the army have been sent to Aldershot from Woolwich. These arms are to be issued; five being given to one of the regiments in each of the infantry brigades. They are to undergo an experimental trial extending over twelve months, during which 2,000 rounds of ball cartridge and 1,000 rounds of blank are to be fired from each rifle. Each infantry regiment at the camp is to have the rifles in turn, and at the end of the experimental trial the commanding officers are to furnish reports on the new arms for the information of the Secretary of State for War and His Royal Highness the Field Marshal Commanding-in-Chief.

## APPLICATIONS FOR
# PROVISIONAL PROTECTION FOR INVENTIONS
## UNDER THE PATENT LAW AMENDMENT ACT.

☞ When the city or town is not mentioned, London is to be understood.

*2nd December* 1869.

3486 H. C. Pennell, Weybridge—Rifles
3487 J. B. Wilson, J. Higginbottom, and I. Royse, Stockport—Bowls or rollers used in calendering
3488 A. Mitchell, Leith—Caissons
3489 F. C. Webb, Regent's Park Road—Submarine telegraphic cables
3490 A. P. Stirling, Peebles—Spittoon
3491 J. H. Johnson, Lincoln's Inn Fields—Spring mattresses.—A com.
3492 H. H. Mayden, Mansfield—Spinning tobacco
3493 J. W. and E. Whittaker, Moses Gate, near Bolton-le-Moors—Steam boiler furnaces and fines
3494 P. A. S. Langlois and L. S. Thomassin, Paris—Sulphuric acid
3495 E. Field, Chandos Chambers, Adelphi—Valves for steam fire-engine and other pumps

*3rd December* 1869.

3496 W. Tatham, Rochdale—Machinery for opening and breaking hard waste rags, &c.
3497 J. Smith, Carshalton, and T. Eastwood, Lambeth—Working and reversing the valves of steam and other engines
3498 J. M. Macintosh, Pimlico—Apparatus for taking up, carrying, and laying sheets of paper delivered by a paper-cutting or other machine
3499 J. C. Wilson, Martin's Lane, Cannon Street—Revolving engine and pump
3500 W. MacLean, Glasgow—Printing, lithographing, and zincographing
3501 J. Jeavons, Sheffield—Manufacture of armour plates
3502 F. V. Neale, Lincoln's Inn—Fastening objects capable of rotating on hinge joints
3503 T. W. Tobin, Regent Street—Electric telegraph apparatus
3504 T. R. Crampton, Great George Street—Burning powdered fuel
3505 H. Larkin and W. White, Hampstead—Production of potassium, sodium, and zinc
3506 J. and S. Loebl, Aldermanbury—Locks for bags, &c.—A com.

*4th December* 1869.

3507 J. Boyd, Glasgow, N.B.—Winding yarn or thread
3508 C. W. Petersen, City road—Life-boats, &c.
3509 J. F. Kent, Thornton Heath, near Croydon—Sawing machine
3510 H. M. Nicholls, Arundel Street, Strand—Cutting continuous paper into sheets
3511 S. Alley, Glasgow—Breakwaters.—A com.
3512 J. Knowles, Burnley—Rotary engines
3513 J. Walker, Clayton-le-Moors, Lancaster—Blankets
3514 H. Alexandre, Paris—Organs
3515 W. Brookes, Chancery Lane—Fluid lenses.—A com.
3516 T. Macguire, Inchicore, Dublin—Packing glands of steam and other engines
3517 A. Ripley, West Square, St. George's Road, and J. Wormald, Blackfriar's Road—Pipe wrench
3518 W. R. Lake, Southampton Buildings—Harness.—A com.
3519 T. Clark, Cheapside—Covers of umbrellas and parasols
3520 S. Chatwood and J. Crompton, Bolton-le-Moors, Lancaster—Self-acting escape valve

*6th December* 1869.

3521 J. L. Booth, Rochester, New York, U.S.A.—Rails for railroads
3522 T. Prideaux, Sheffield—Purifying and calcining gas and soap limes
3523 W. Shanks, Johnstone, Renfrew—Forging horse-shoes
3524 H. H. Murdoch, Staple Inn—Forming and joining the ends of iron and other tubes or pipes.—A com.
3525 J. B. Spence, Manchester, Manufacture of alum
3526 J. B. Spence, Manchester—Substance to be used in the manufacture of paper in a similar manner to alum or sulphate of alumina
3527 W. R. Lake, Southampton Buildings—Hulling grain or seed.—A com.
3528 W. Geeves, Barnbury—Capsules or packages for containing tea, &c.

*7th December* 1869.

3529 D. Robertson, W. L. G. Wright, and J. More, Glasgow, N.B.—Apparatus for forcing and projecting liquids and fluids
3530 S. Lewin, Poole—Elevators for raising and stacking straw, hay, &c.
3531 H. P. de Meyrignac, Paris—A tubular apparatus for brushing and wet-rubbing hair
3532 J. Swift, Ashton-in-the-Willows, near Wigan—Safety lamps to be used in coal-mines
3533 G. Dowler, Birmingham, and W. Pursall, Aston, near Birmingham—Cartridges for breech-loading firearms
3534 J. Jonas, Fenchurch Street—Apparatus for packing and consolidating tea, &c.
3535 B. J. B. Mills, Southampton Buildings—Securing bales of fibrous and other substances.—A com.
3536 W. Scott, Hawick, N.B.—Furnaces
3537 J. Watson, Montrose, N.B.—Electric telegraph apparatus for continuous printing
3538 C. Vavin, Paris—Apparatus for separating metals and magnetic substances from other bodies
3539 F. A. Harrison, Birmingham—Buckle or fastening for braces, belts, &c.
3540 J. Childs, Victoria Street—Manufacture of bread and biscuits
3541 J. H. Johnson, Lincoln's-Inn-Fields—Crucibles, melting pots, retorts, furnaces, &c. A com.
3542 C. Wyndham, Southover, near Lewes—Apparatus connected with velocipedes

*8th December* 1869.

3543 E. Edwards, Willesden Lane—Photo-mechanical printing
3544 J. S. Robertson, Glasgow, N.B.—Horse-shoes for frosty or snowy weather
3545 M. Kolb, New York, U.S.A.—Screw propellers
3546 E. Weldon, Sheffield—Portable apparatus provided with means for carrying and cooking food, &c.
3547 M. Stell, Bradford—Machinery for twisting or doubling worsted, &c.
3548 G. Preston and J. Prestige, Deptford—Apparatus for regulating the supply of water to water-closets
3549 B. F. Stevens, Henrietta Street, Covent Garden—Working of glass.—A com.
3550 M. F. Anderson, Edinburgh—Treating sewage
3551 A. L. Bricknell, Stratford-upon-Avon—Gates
3552 A. M. Clark, Chancery Lane—Ornamenting figured muslin and gauze fabrics.—A com.

*9th December* 1869.

3553 H. S. Rush, New Cross, Kent—Railway chairs
3554 E. Walker, Heckmondwike—Gas burners
3555 W. Johnson, Sketty, Glamorgan—Machinery for pressing wool, cotton, hemp, &c.
3556 H. Pyk, Leipsic—Improvements to refine paraffin and render it white
3557 W. Tranter, Birmingham—Firearms
3558 J. Loader, Upper Clifton Street, and W. H. Child, Worship Street—Liquid meters
3559 D. Clayton, Bradford—Shuttles
3560 C. Sipriot, Milan—Apparatus for exhibiting placards, posting-bills, &c.
3561 J. Hamilton and R. Paterson, Glasgow, N.B.—Collapsable casks or vessels for containing fermentable and aerated beverages
3562 W. R. Lake, Southampton Buildings—Vices.—A com.
3563 J. F. Alexander, New York, U.S.A.—Undulating propellers for steam ships
3564 R. A. Ballon, Massachusetts, U.S.A.—Fire-resisting safes, steam boilers, pipes, &c. A com.
3565 C. A. McCalla, Birmingham—Closing and stoppering bottles, tubes, &c.
3566 J. Ballantyne, Walkerburn, near Innerleithen, Peebles, N.B.—Manufacture of yarns or threads

*10th December* 1869.

3567 H. Whittaker, Manchester, and W. Bradbury, Prestwich—Connecting the ends of packing hoops or other metal hoops or bands
3568 H. Kershaw, Laister Dyke, near Bradford—Apparatus employed when spinning worsted, &c.
3569 G. F. Logan, Glasgow, N.B.—Utilising waste heat and for consuming smoke
3570 W. E. Gedge, Wellington Street, Strand—Velocipedes—A com.
3571 J. Willis, Stocksbridge Works, near Sheffield—Manufacture of sunshades and umbrellas
3572 T. S. Sarney, Sheffield—Fishing or connecting railway rails
3573 A. M. Clark, Chancery Lane—Ornamentation of shell brooches, &c.—A com.
3574 W. Baines, Smethwick—Apparatus for actuating and controlling railway signals and switches, and for working railway turntables
3575 R. J. Ransome, Ipswich, J. Deas, Glasgow, and R. C. Rapier, Westminster Chambers—Tramways
3576 W. Yeoman and J. Gilbert, Walworth—Shuttle sewing machines

*11th December* 1869.

3577 W. Downing, Sheffield—Breech-loading cartridge with lubricating ball
3578 J. Barnett, Chelsea—Fuel for heating and warming
3579 G. White, Islington—Apparatus used for steering, controlling, and propelling steam ships, &c.
3580 T. Sagar, T. Richmond, and C. Catlow, Barnley—Looms
3581 A. A. Croll, Coleman Street—Treatment of ammoniacal liquor of gasworks, to obtain therefrom salts of ammonia
3582 W. E. Newton, Chancery Lane—Apparatus for folding printed sheets of paper and for cutting and folding printed sheets of paper as they issue from the printing machine—A com.
3583 J. T. Parlour, Brooklyn, New York, U.S.A.—Raising sunken ships, &c.
3584 E. Simcoe, Harpenden, Wilts—Case or portfolio for filing music, and business and other papers
3585 W. I. Hetherington, Manchester—Engines
3586 T. Moore, Aston, near Birmingham—Knobs for doors, bedsteads, &c.
3587 W. A. Marshall, Canonbury—Electric telegraph cables
3588 H. Cockey and F. C. Cockey, Frome Selwood, Somerset—Steam boilers
3589 W. C. Green, Duck Lane, Edward Street—Breech-loading firearms
3590 H. Wilson, Stockton-on-Tees—Machinery for cutting timber into laths, strips, flooring, and other boards and pieces, &c.
3591 W. Williams, Liverpool—Subaqueous and tunnel communications

*13th December* 1869.

3592 T. Rawsthorne, Preston—Putting twist into sliver or yarn from the flyer eye to the front rollers of frames for cotton, woollen, or other fibrous substances
3593 P. Koch, Manchester—Manufacturing untapped nuts intended for screw bolts
3594 J. Turner and J. Turner, Rochdale—Lubricators for steam-engines
3595 H. Watson, Steeton-in-Craven, York—Machinery for smoothing, marking, and oiling bobbins
3596 G. Oldroyd, J. Oldroyd, and M. Oldroyd, Dewsbury—Weaving
3597 W. R. Lake, Southampton Buildings—Preserving dead human bodies and animal carcases.—A com.
3598 J. G. Tongue, Southampton Buildings—Sewing or stitching together the numbers or separate parts of a volume in the operation of bookbinding.—A com.
3599 E. A. Cowper, Great George Street—Rotary sieves
3600 P. C. Evans, Brimscombe Mills, Gloucester, and H. J. H. King, Glasgow—Apparatus for feeding wool, cotton, or other fibrous materials to carding or other machines
3601 A. Barr, Glasgow, N.B.—Apparatus for blowing organs
3602 W. Asquith, G. Bootb, and G. Pickersgill, Halifax—Machinery to be employed for cutting and boring metals
3603 H. E. Newton, Chancery Lane—Net machines—A com.
3604 R. J. Carpenter, Old Broad Street—Manufacture of iron and steel.—A com.
3605 J. Gardner, Bootle—Cutting veneers.—A com.
3606 R. W. Bernard, Kildare—Candle lamps or imitation candles.—A com.
3607 J. Livesey, Victoria Chambers, Westminster—Street tramways, light permanent way, and temporary railroads

*14th December* 1869.

3608 T. Moore, Aston, near Birmingham—Castors for tables, &c.
3609 J. Barlow and Edward Pilkington, Bolton—Looms
3610 B. B. de Morell, Berne, Switzerland—Raising navigable vessels or other heavy bodies above the surface of the water
3611 W. Hepple, Low Walker, near Newcastle-on-Tyne, and M. Stainton, South Shields—Furnace bars and furnaces
3612 W. and W. McGee, Paisley, N.B.—Machinery for doubling and winding fibrous materials
3613 R. Morton, Stockton-on-Tees—Refrigerators or apparatus for cooling liquids
3614 P. Parkes, West Bromwich—Machinery for cutting or shaping screw nuts and the heads of bolts, &c.
3615 W. E. Newton, Chancery Lane—Harness for looms.—A com.
3616 W. E. Newton, Chancery Lane—Rotary engines.—A com.
3617 G. W. Honeyman, Gateshead-on-Tyne—Preparation for the removal and prevention of incrustation in steam boilers

*15th December* 1869.

3618 W. C. Homersham, Willes Road, Kentish Town—Pipes and conduits
3619 N. P. Burgh, Waterloo Road, Lambeth—Double or single acting pump
3620 W. R. Lake, Southampton Buildings—Apparatus for making and breaking electro-magnetic circuits.—A com.
3621 E. Moss, Old Broad Street—Self-acting malt-drying apparatus,—A com.
3622 E. Johnson, Manchester—Granaries, &c.—A com.
3623 W. K. Stock, Darlington—Looms
3624 J. Hamer, White Horse Yard, Holborn—Steam engines
3625 J. Askew, Hampstead Road—Globular refrigerator for cooling brewers' and distillers' wort
3626 J. Outram, Sevenoaks—Propelling vessels
3627 J. H. Sams, Aberdeen, N.B.—Seed-sowing machines and manure distributors
3628 E. T. Hughes, Chancery Lane—Wood-moulding and panelling machines.—A com.
3629 T. Parry, Balbam, and J. McHardy, Edinburgh, N.B.—Drag or brake
3630 A. Hall, Huddersfield—Improved fabric
3631 G. Seymour, Lime Street—Ships and vessels
3632 J. S. Battye, Stirling, N.B.—Mechanism for spinning woollen and other yarns
3633 J. H. Johnson, Lincoln's Inn Fields—Apparatus for reducing friction.—A com.

16*th December* 1869.

3634 J. Heap, Hampstead Road—Earth closets or commodes and urinals
3635 E. Tomlinson, Manchester—Furnaces
3636 J. W. Greenwood, Upper Holloway—Fastening for buckles
3637 W. T. Henley, Leadenball Street—Protecting telegraph wires and cables
3638 S. Johnson, West Croydon—Velocipede carriages
3639 J. O. Butler and J. Nichols, Leeds, and W. Heslop, Doncaster—Wheels and pulleys
3640 G. Wilson, Sheffield—Railway wheels
3641 W. Richards, Birmingham—Breech-loading firearms and cartridges
3642 J. Outram, Sevenoaks—Steam motive-power engines
3643 S. A. Buirat, Paris—Producing engraved metallic plates for commercial indications
3644 F. E. Duckham, Millwall—Hydrostatic weighing machines
3645 A. M. Clark, Chancery Lane—Manufacture of superphosphate of lime.—A com.

17*th December* 1869.

3646 J. Ghisi, Lodi, Italy—System of spherical ship, with circular steam engine, for the use of marine locomotion, &c.
3647 A. R. Stocker, Horsleydown—Stoppers for infants' feeding and other bottles
3648 H. Willett, Brighton—Groynes and breastworks
3649 L. Sterne, Great Queen Street—Buffers
3650 G. Weir, Glasgow, N.B.—Slide valves.—Partly a com.
3651 W. Foulds, Paisley, N.B.—Feed-water heaters.—A com.
3652 W. Barrs, Manchester—Manufacture of elastic webbing
3653 R. Idle and G. Naylor, Earls Heaton, near Dewsbury—Apparatus for consuming smoke
3654 E. A. Inglefield, Grove End Road—Hydraulic apparatus to be used on shipboard for utilizing the pressure of the external water
3655 J. L. Hancock, Sutton Coldfield, Warwick—Apparatus for crushing or breaking bones
3656 T. C. March, Ambassadors' Court, Saint James' Palace—Ornamentation of articles of furniture, &c.
3657 G. Rhodes, Lincoln—Apparatus for actuating the valves of steam engines
3658 A. M. Clark, Chancery Lane—Jacquard apparatus.—A com.

18*th December* 1869.

3659 W. Carver, Manchester—Sewing machines
3660 R. C. Goddard, Stockport—Portable cooking apparatus
3661 J. C. Martin, Barnes—Manufacture of finings as a substitute for isinglass
3662 W. E. Gedge, Wellington Street, Strand—Improved system of pessary.—A com.
3663 W. Hargreaves, Bolton—Steam boilers
3664 W. Foulds, Paisley, N.B.—Apparatus to promote circulation in steam boilers.—A com.
3665 J. Smiles, Birmingham—Breech-loading firearms
3666 W. Potts, Handsworth, Stafford—Apparatus for effecting or promoting the ventilation of rooms or buildings and for preventing down-draught in chimneys
3667 R. Nevill, Llanelly, Carmarthen—Retorts and annealing pots and stands
3668 J. C. Ramsden, Bradford—Looms
3669 J. M. Shiels, Preston Pans, N.B.—Preparing malt or grain for brewing or distilling
3670 S. Butler, Nottingham—Manufacture of lace in twist lace machines
3671 S. Giles, Brewer, Borough—Apparatus to be used in the fermentation of worts, &c.
3672 D. W. Bailey, Chelsea, Suffolk, Massachusetts, U.S.A.—Laying composite pavements for streets
3673 H. Kinsey, Nottingham—Surface condensers, hot-water apparatus, &c.
3674 L. Woodward, Nottingham—Knitting frames
3675 G. T. Bonsfield, Brixton—Treatment of aromatic secondary monamines for obtaining colouring matter.—A com.
3676 W. L. Wise, Chandos Chambers, Adelphi—Instrument for levelling and for measuring angles.—A com.
3677 J. Robertson, Glasgow, N.B.—Treating and shaping metals

20*th December* 1869.

3678 G. Ermen, G. A. Ermen, Manchester, and W. Foster, Pendlebury—Brushes for polishing yarns or threads, &c.
3679 M. Henry, Fleet Street—Apparatus for typographical composing and printing.—A com.
3680 F. Ellershausen, Ellershause, Nova Scotia, and T. Weble, New York, U.S.A.—Apparatus for utilizing the force of the waves
3681 G. Newsum, Hunslet, Leeds—Pumping
3682 G. T. Livesey, Old Kent Road—Apparatus used in the manufacture of gas
3683 W. Morris, South Hackney—Permanent way
3684 E. T. Hughes, Chancery Lane—Garments to be worn next the skin for sanitary purposes.—A com.
3685 J. Wild, Rochdale, and J. Smith, Halifax—Manufacture of pile fabrics
3686 J. H. Richardson, Poultry—Boxes or cases for packing and carrying eggs.—A com.
3687 C. D. Abel, Southampton Buildings—Ploughs and cultivators.—A com.
3688 T. Shakespear and G. Illston, Birmingham—Sewing machines
3689 A. M. Silver, Wood Street, and F. White, Camberwell—Apparatus for indicating time
3690 G. W. Galloay, Francis Street—Joints or couplings for pipes, rods, &c.
3691 C. Fraswer, Bromley-by-Bow—Disinfecting or drying clothes, bedding, &c.

21*st December* 1869.

3692 H. M. Marsden, Sheffield—Sheep shears, &c.
3693 W. E. Gedge, Wellington Street, Strand—Machinery for shearing and cleansing woven fabrics.—A com.
3694 W. E. Gedge, Wellington Street, Strand—Self-acting apparatus for preventing accidents from steam machinery.—A com.
3695 H. Green, Preston—Lubricators
3696 D. G. Fitz Gerald, Battersea—Electric telegraphs
3697 W. R. Lake, Southampton Buildings—Manufacture of steel, &c.—A com.
3698 J. Martin, Leeds—Rendering cloth and other fabrics and materials repellent of water
3699 W. Ferrie, Monkland Iron and Steel Works, Lanark, N.B.—Blast furnaces
3700 W. Gossage, Widnes—Treating gases evolved during the processes of smelting copper ores
3701 R. W. Pyne, Belvedere Road, Lambeth—Mann-motive and pedo-motive carriages or vehicles

22*nd December* 1869.

3702 J. Loader, Upper Clifton Street, and W. H. Child, Worship Street—Steam boilers
3703 J. Pritchard and J. Collins, Glasgow, N.B.—Embroidering or sewing
3704 J. M. Gray, Liverpool—Marine compound steam engines
3705 J. Bourne, Mark Lane—Production of heat, and the generation and application of motive power derived therefrom
3706 J. Brooke, Huddersfield—Manufacture of blankets, &c.
3707 H. Bessemer, Queen Street Place, Cannon Street—Steam vessels and sailing vessels
3708 G. Fuller, G. Spencer, and E. Martin, Horsleydown—Feeding-bottles
3709 J. Asbury, Balsall Heath, Worcester—Screw wrenches or screw spanners
3710 W. B. Williamson, Worcester—Fastenings for trunks, &c.
3711 W., T. and J. McKenzie, Dublin—Apparatus for sharpening the cutters of mowing machines.—A com.

23*rd December* 1869.

3712 R. Turner, Manchester—Machinery for preparing, twisting, or spinning cotton, &c.
3713 E. Ibos, Paris—Manufacture of boot and shoe soles
3714 J. Rae and J. Wright, Copthall Court—Supplying inland towns with pure salt sea-water for bathing, &c.
3715 B. Hunt, Serle Street—Railway sleepers or supports.—A com.
3716 J. Woodward, Darlington—Manufacture of bricks, tiles, &c.
3717 J. B. Gongb, Rbyl, Flint—Collar stnd
3718 C. H. Roeckner, Upper Thames Street, and W. H. Nortbcott, Mark Lane—Disintegrating wood
3719 R. Spear, Newhaven, Connecticnt, U.S.A.—Pneumatic engines for raising water
3720 R. Spear, Newhaven, Connecticut, U.S.A.—Governors for steam and otber engines
3721 J. C. Walker, Hackney Wick—Constructing and heating cooking and laundry stoves
3722 W. E. Newton, Chancery Lane—Adjusting and packing the rails of railways.—A com.
3723 W. E. Newton, Cbancery Lane—Forming the joints of the permanent way of railways.—A com.
3724 H. E. Newton, Chancery Lane—Traction engines.—A com.
3725 A. M. Clark, Cbancery Lane—Materials to be used as curtains and blinds.—A com.

24*th December* 1869.

3726 W. Snmner and E. H. Waldenstrom, Manchester—Machinery for boring copper and its alloys for making cylinders, rollers, and tubes
3727 W. Sumner and E. H. Waldenstrom, Manchester—Manufacture of cylinders, rollers, and tubes of copper and its alloys
3728 R. Thomas, Liverpool—Propelling steam sbips
3729 G. E. Born, South Place, Finsbury—Loaf-sugar cutting machines.—A com.
3730 G. M. F. Molesworth, Bideford—Rails employed with grip wheels for facilitating the working of traction engines
3731 J. Hargreaves and T. Robinson, Widnes—Treatment of pyrites
3732 P. Currie, Glenfield, N.B.—Macbinery for tentering and drying woven fabrics
3733 W. H. Baxter, Brixton Hill—Apparatus for weighing or measuring corn, &c.
3734 W. McAdam, Glasgow, Lanark, N.B.—Collecting fares or payments on tramway cars, omnibuses, and on railways, &c.
3735 T. G. McDiarmid, Southampton—Rig of ships and vessels
3736 W. R. Lake, Southampton Buildings—Manufacture of metal tubing.—A com.
3737 W. E. Newton, Chancery Lane—Heating water.—A com.
3738 W. White, Malpas Road, Lewisham Road—Velocipedes
3739 F. F. Benvenuti, Swansea—Feeding inkstand
3740 S. Dixon, Nottingham—Skirts, petticoats, &c.
3741 S. Walker and E. Holt, Radcliffe—Steam pumping engines
3742 H. J. and J. W. Girdlestone, Norfolk Street, Strand—"Dry" closets, commodes, and urinals
3743 C. Drake, Hammersmith Road—Portable cooking stove
3744 N. Grew, New Broad Street—Apparatus for measuring the weight or volume of water or other fluid supplied to steam boilers or other vessels and the quantity of caloric transmitted to the same.—A com.

27*th December* 1869.

3745 E. P. H. Vaughan, Cbancery Lane—Manufacture of fluoride of potassium and sodium, and of bydrate and carbonate of potasb and soda.—A com.
3746 T. H. Lloyd, Stockport, Chester—Safety valves
3747 F. W. Webb, Bolton—Mills for rolling and crushing metals and other materials
3748 C. A. Marriott and E. Holt, Newton Heath, near Manchester—Steam engines
3749 P. Pierce, Wexford, Ireland—Horse or other gearing
3750 W. Adams, Birmingham—Breech-loading firearms

28*th December* 1869.

3751 L. Schalleidner, Paris—Apparatus for stamping wax and other candles
3752 G. Spencer, Cannon Street—Machinery and apparatus, and processes, for the preservation of animal and vegetable substances
3753 C. Gordon, Goswell Road—Breech-loading firearms
3754 W. R. Lake, Southampton Buildings—Sectional steam boilers.—A com.
3755 G. W. Rawson, Massachusetts, U.S.A.—Promoting the combustion in a furnace of the smoke and gases resulting from the fuel thereof
3756 A. Upward, Goswell Road, J. Bannehr, Great Queen Street, and the Rev. T. P. Dale, Notting Hill—Manufacture and purification of gas, &c.

29*th December* 1869.

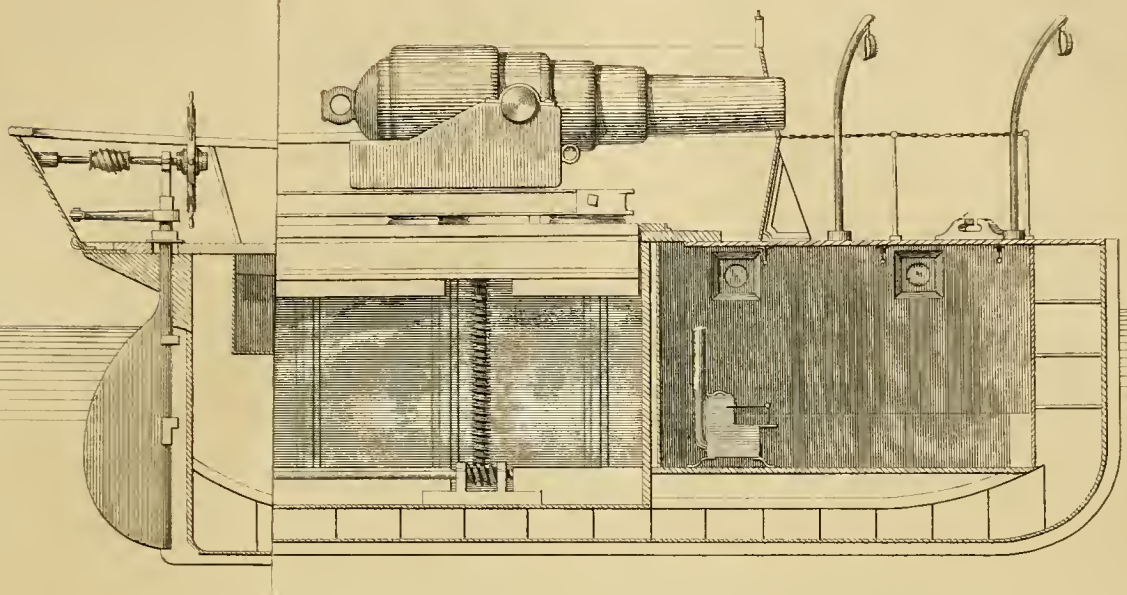
3757 R. H. Kay and A. T. Richardson, Mobberly, Chester—Manufacture of crape
3758 W. Sinnock, Bow, and J. Polglase, Bodmin—Machinery for crushing ores
3759 P. Gledhill, Newcastle-on-Tyne—Machinery for cutting coal and other minerals
3760 T. Edwards, Birmingham—Condensing steam engines
3761 B. G. Herrmann, Swansea—Separation of metals
3762 W. E. Newton, Cbancery Lane—Improvements in tilting vessels or utensils, and in stands or supports for the same.—A com.
3763 W. Richards, Birmingham—Breech-loading firearms and cartridges

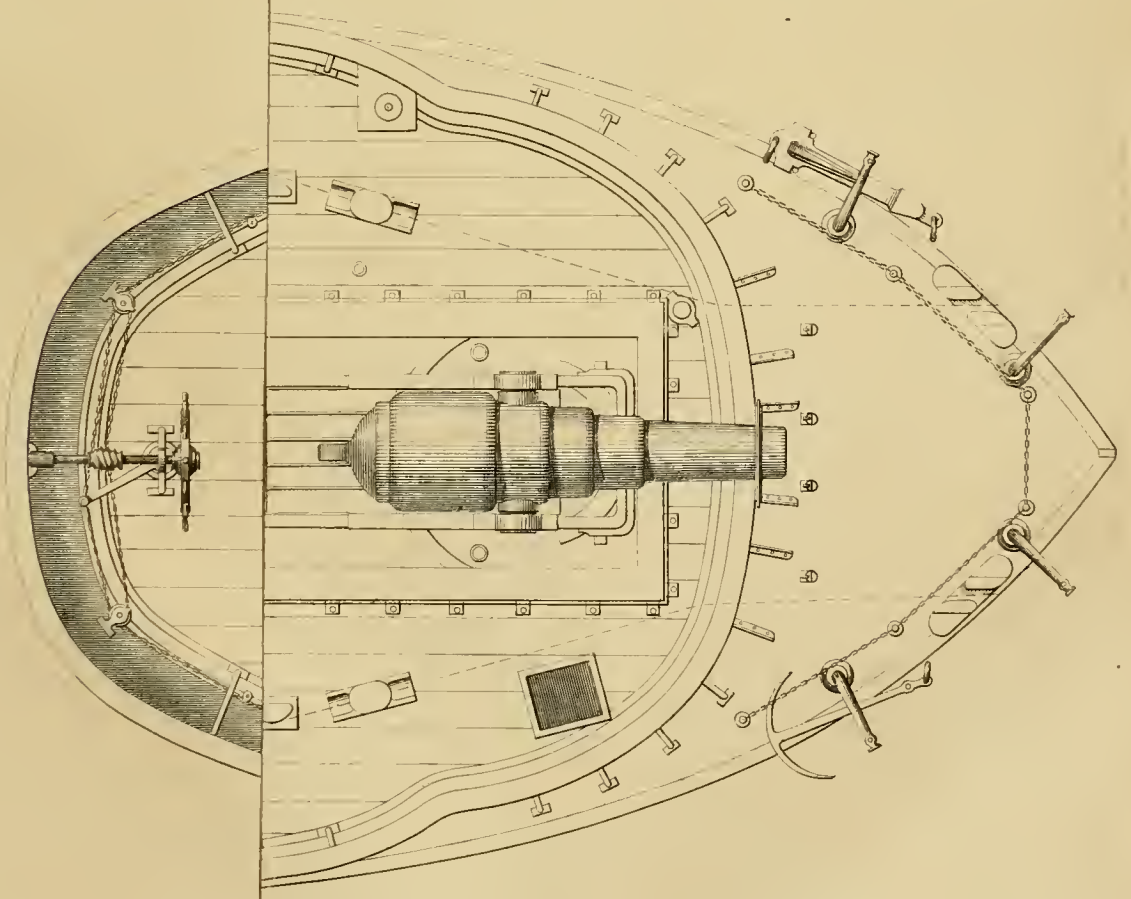
30*th December* 1869.

3764 H. N. Maynard, Crumlin, Monmouth—Piers or supports for bridges, viaducts, lighthouses, beacons, jetties, breakwaters, &c.
3765 W. H., J., M., and T. Helliwell, near Todmorden, York—Bobbins
3766 J. O. Butler and J. Nichols, Leeds, and W. Heslop, Doncaster—Tyres and hoops for railway wheels, &c.
3767 C. W. Petersen, City Road—Life-boats, &c.
3768 R. Derham, Bermondsey—Apparatus for washing potatoes
3769 W. R. Lake, Southampton Buildings—Apparatus for roasting iron pyrites.—A com.
3770 J. Howard and E. T. Bousfield, Bedford—Steam boilers
3771 J. R. Wigham, Monkstown—Gas burners for illuminating beacons, buoys, and lighthouses
3772 G. T. Bousfield, Brixton—Harness-operating mechanism for power looms.—A com.
3773 T. Whitby, Wellesley Road—Bedsteads, &c.
3774 J. Stanton, Wolverhampton—Gun-lock
3775 J. H. Johnson, Lincoln's Inn Fields—Production of cast-iron, iron, and steel.—A com.
3776 J. H. Johnson, Lincoln's Inn Fields—Manufacture of iron and steel.—A com.

31*st December* 1869.

3777 W. H. Richardson, Glasgow, N.B.—Indicating or stamping with the standard mark or otherwise crystal or glass measures for containing spirits, beer, &c.
3778 A. Matthiessen, Carlton Hill, St. John's Wood—Insulating substance for the covering of electric telegraph conducting wires, &c.
3779 G. Hamilton, Smethwick—Steam boilers
3780 H. E. Newton, Chancery Lane—Electro-magnetic engines.—A com.
3781 A. Bradshaw, Accrington—Printing machines
3782 T. F. France, Wigan—Baths and waterclosets
3783 C. A. Calvert, Manchester—Apparatus for self-registering and checking the money taken for admission to public entertainments, &c.
3784 A. Chaplin, Lavender Hill, Surrey—Steam boilers
3785 F. J. Bolton, Belgrave Road—Treatment of fermented liquors
3786 J. Wright, Rochester—Indicating the mileage of cabs, &c.





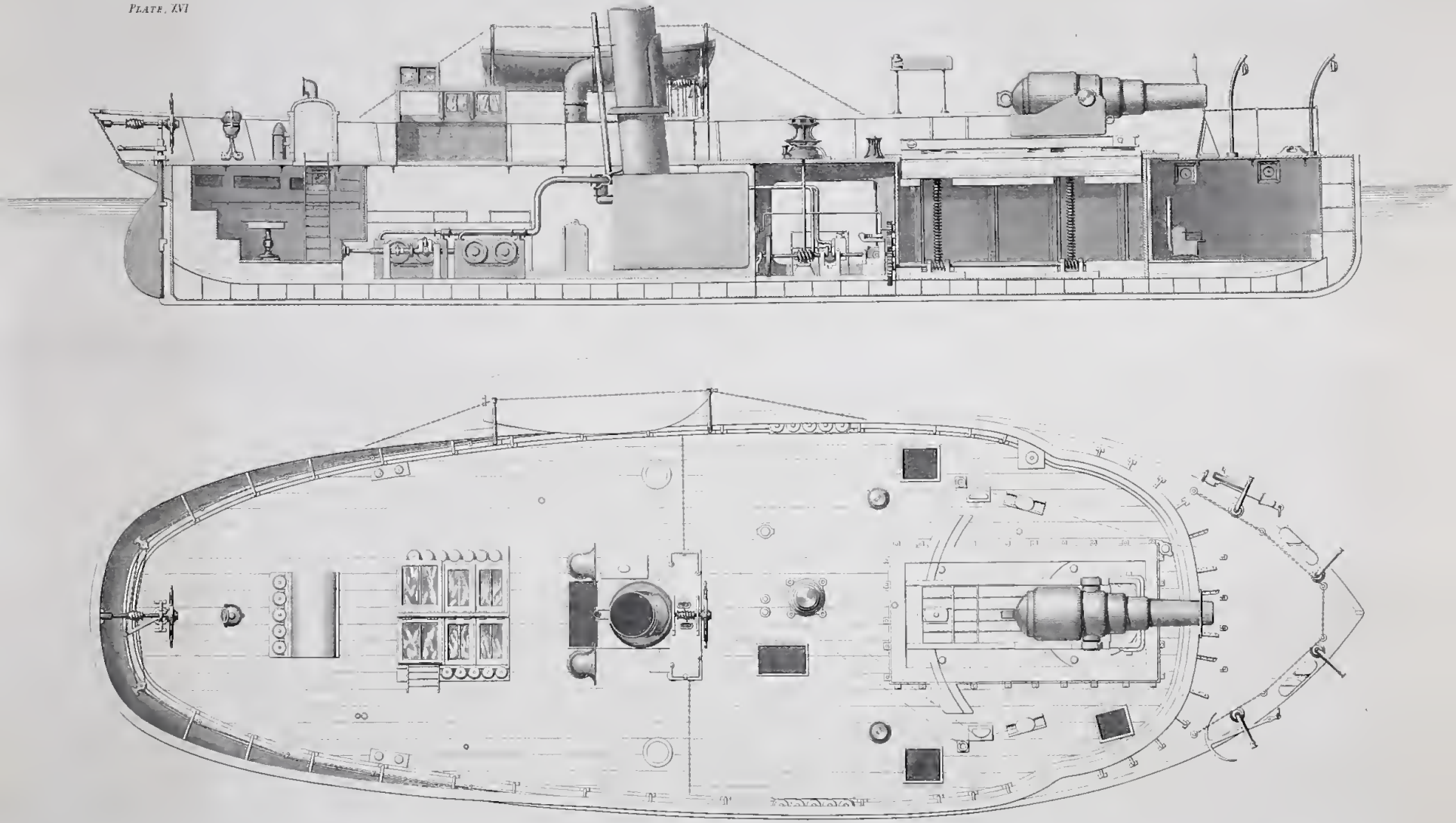
Dunn & Wright Glasgow
Lith

March 1870
Practical Mechanics Journal
Plate. XVI

# THE GUNBOAT "STAUNCH."

DESIGNED BY Mr. RENDELL,
ELSWICK COMPANY'S WORKS.

Third Series
Vol. 5



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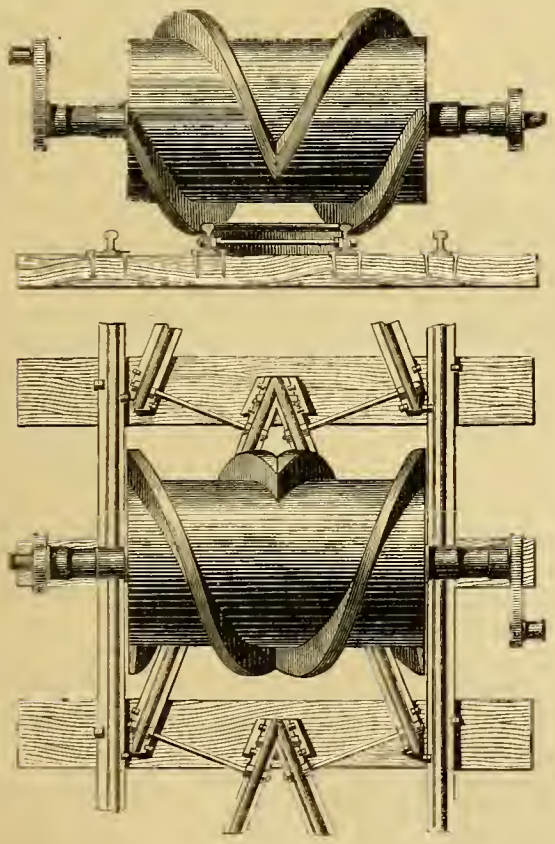
## THE WETLI SYSTEM OF LOCOMOTION FOR STEEP INCLINES.

THE penetration of the great Alpine chains by railways, already, we may say, accomplished over the Brenner and Mont Cenis, and now not far from being commenced over the St. Gothard, and to be followed no doubt, within the next twenty years, by lines over many other great mountain chains in Europe and Asia, has called for several new projects for meeting the difficulties which exist in giving sufficient adhesion with the ordinary locomotion.

Mr. Fell's, originally M. Vignolles's, mid-rail system, as actually at work over Mont Cenis, is one of these; the highly ingenious Italian wire-rope traction system, as exhibited in the Parc at Paris in 1869, is another. The atmospheric railway system was anterior to all. Mr. Fairlie proposes, on acknowledged principles and without changing anything essential to ordinary locomotive working, to effect this removal of difficulty by merely increasing the number of points of rolling adhesion and diffusing the whole load upon these equally; and there have been several other schemes which we need not refer to in particular, as being more or less chimerical.



We have now a new proposal, for we think, whatever else may be said of this system of M. Wetli's, that it is new in application at least. Our engraved figure will at a glance enable our mechanical readers to comprehend in what mainly it consists. Dr. Hooke's stepped spur-wheels or spiral gear—which is well enough known not to need our referring to it further than to say it consists in engaging wheels whose teeth have faces inclined to the axes of rotation, and may be regarded in fact as portions of the threads of a screw being one wheel, and of an endless nut being the other, and which threads necessarily only touch at one point at any movement, these points of contact passing over the whole length of each tooth successively as one tooth passes after the other—this system of gear constitutes the basis of the Wetli system. In an ordinary pair of Hooke's spiral spur-wheels the teeth slope only in one direction, *i.e.* looked at on edge the teeth of either wheel at the axis level slope off lowest at the left-hand or *vice versâ*. It results from this that the mutual pressure of the teeth of the two wheels produce a laterally resolved pair of forces tending to cause the wheels to slip asunder sideways or along their axes, were they free to do so, in opposite directions. Were two pairs of such spiral-toothed spur-wheels set side by side however, and keyed on their parallel axes with the slopes of the teeth of one pair *reverse* to those of the other, these resolved forces being mutually neutralised, there would be no longer any resultant in the line of the axis of either.

Now, if in place of one of the pairs of such spur-wheels, we substitute a spiral-toothed *rack*, that is to say, a wheel whose radius is infinite, we have complete the elements of the Wetli system. The rack is the railway, between the rails of which are laid two sets of diagonal bars at intervals, pointing towards each other and meeting in the centre of the gauge of way. These are the spiral teeth of the rack. The driving-wheel of the locomotive to be employed consists of a cylindrical drum of the same diameter nearly, and keyed upon the same axis with the main bearing wheels of the locomotive, or upon more than one such axis. Upon the exterior of this drum are fixed projecting spirals which take into or engage with the spiral teeth or diagonal rails of the way, nipping together at two opposite points abreast of each other at the same time, and these bearing points rolling successively from the outer part next the rails to the centre part or middle of the way, and as they roll, dragging on the engine and train as though upon one of the ancient Blenkinsop tooth-and-rack colliery engines and railways of the north of England of præ-Stephensonian days, but always without any rattle or blows or backlash.

Before one double spiral pair of teeth have lost their hold, a second pair as before have got engaged, and so the gear between engine and railway is constant. That locomotion, and very steep locomotion, *can* be thus effected does not admit of doubt; and were it possible to ensure such accuracy and exactitude as to gauge of way, position and firmness of holding down to the sleepers, on the part of the diagonal bars or spirals between the rails, and sufficiently perfect uniformity of level always between the rails and these spirals—in a word, if we could ensure such a state of things as we should have were the rails and spirals between them all of cast-steel and in one piece, and bedded and secured down upon solid rock, then we should add that this method had been brought into a practicable state.

Unfortunately, however, such are not the conditions of any railway which are possible, for however short a time; and they are such as the contingencies of traffic, of wear and tear, of weather, and of the accidents of Alpine climates, oblige the widest divergence from however well a line be designed, or however well its maintenance be attended to. Rails must be secured to sleepers of some sort; these must sit on ballast, more or less elasticity and yield of the way must be provided for. The rails, therefore, constantly alter their level and their position in all three possible directions more or less, and more or less carry with them the sleepers which at once sustain them and hold them to the earth. These spiral bars or diagonal mid-rails must be secured to the sleepers, and so must partake of their mobility. Furthermore, the ballast itself is subject to rain and frost, weather and floods, and often compels movement in the sleepers fixed in it, or goes away altogether, and leaves these partially unsupported.

All these, we fear, inevitable irregularities seem to present difficulties in securing the effective, constant, and certain hold between these spiral teeth in the engine and the rail spirals that appear as yet without a solution.

We do *not* say they are *impossible* to be met, and met within those limits of expense, and of what we may call flexibility in the system of the way, that are indispensable to enable it to be passed round curves, to sustain drought and floods of rain, and so forth, which must be paramount provisions in every permanent-way system.

And we can easily see that some of the doubts and difficulties which first present themselves to the practical consideration, admit of solution. Thus it must occur to anyone that the effect of any slippage upon a steep ramp, between the driving spirals and the fixed rail spirals, must prove disastrous, inasmuch as those spirals which should come into collision again directly after such slippage

or loss of bite, would strike each other with the conjoint velocity of the slip backwards of the engine and train, and that of rotation of the driving drum spirals, the engine, too, for the moment, running away nearly as if in free air. But were there two or more driving drums on the Fairlie plan, in some degree under the same or under two closely following engines, so as to occupy in all several yards in length of the way, such a general slippage would be almost impossible, one or more of the driving drums being always in hold. The *riding* of one spiral upon another by any misfortune would be a more formidable accident, but it is not hard to see that that also may be met.

The inventor of this system, M. Wetli, is an engineer, we believe, engaged in practice in Switzerland; and his system there has seemed sufficiently important and feasible that the High Federal Council (analogous to our Upper House of Parliament) of the Confederation has demanded a report upon it from the Council of the Polytechnic Federal School. That report, signed on behalf of the reporters by M. Charles Pestalozzi, dated at Zurich in August last, was presented to the Swiss Parliament, and has since been published at Berne, along with a very able report by Professor Culmann of Zurich, and a very clear description of the principles engaged has been produced by Professor Gustave Zeuner, whose reputation is well established even in Great Britain, and Professor Georges Veith, also of Zurich.

All these authorities admit the possibility, and are disposed to presume on the feasibility in practical working of the system, the conceivable difficulties and objections presented by which they have very fully discussed.

It is one of those cases, however, to which we may apply the German proverb, "Probiren geht über studiren," or, as they say in the potteries, "Nothing beats a trial." Experiment, and that upon a large and costly scale, and after careful design of the best thought-out details of plan, can alone really decide whether this would or would not prove a desirable method of railway climbing of Alpine passes.

As regards cost, the official reporters estimate the Wetli way, as designed by the inventor for the double line of St. Gothard, at 767,000 francs per kilometer, or only 15,000 per kilometer greater than that of the same way on the ordinary system of locomotive.

The difference looks small, and the cost may be underrated, but if it is to be weighed against that of a tunnel through St. Gothard like that through Mont Cenis, then, as respects first cost, there can be no room for doubt as to which is the cheaper. That, however, is far from being the whole question; maintenance, durability, and cost for traction per ton per mile on the assumed traffic, for a prolonged period, say for twenty years, have to be taken into account if the relative cheapness as methods of transport be really to be compared; and these must present many items in favour of the tunnel, or rather many tunnels, though charged with the interest of a no doubt enormous capital expended in its or their production.

On the other hand, the longest way between two points connected by rail must always be the most costly in outlay and in working, and the moderate gradients *must* always be the longest way.

One form of rack or toothed rail, and different from this of M. Wetli, viz. that of M. Riggenbach, is about forthwith being tried upon a small line of Swiss railway, which, when completed, will probably be one of the most curious, as it undoubtedly will be one of the most interesting, in the world. It has been decided to connect Lucerne with the summit of the Rigi Alp by a line of railway, which, allowing for irregularities in the contour of the ground, is to wind up round the mountain like the fusee of a watch.

The plan of Herr Rach proposed for this does not seem to us nearly as feasible as this of M. Wetli.

Upon the latter plan Signor Agudio, who has given much attention to railway construction of steep ramps, has proposed some modifications, which, however, do not appear to us important as improvements.

In conclusion, this Wetli plan is certainly well worthy of being tried, and there are a good many spots, even in our own country, where the experiment must be made, and, if successful, with permanent advantage to the projectors.

## MR. HENRY AITKEN'S METHODS OF TREATING CERTAIN IRONSTONES.

These methods briefly consist in more or less strongly heating, in close or nearly close vessels, the iron ores to be operated upon, in lieu of calcining the same in kilns or ovens, with a free draught of air. It is roasting without oxidation, or with but little, in place of roasting with such freedom of oxidation as affects all the constituents of the ores.

And as it is alone applicable or proposed by the inventor being applied to ores, such as clay ironstones from the coal measures, rich in carbon, like the well-known black bands, and since the carbon in such ores exists very generally in two states, viz. as more or less volatile coal oils, bitumens or other such hydrocarbons, and also as diffused solid carbonaceous particles, and as only the former portion of the carbon contained is proposed being expelled or burnt in Mr. Aitken's method of roasting, so he has not improperly called the process "coking" these ores. In this Journal, 1st March 1868, this process was first noticed, and in the part for 1st October of same year a sufficiently full account was given of the apparatus and methods of procedure, illustrated by figures taken from the specification drawings. It will be unnecessary to say more here, therefore, than that the four patents of Mr. Aitken are numbered and dated respectively No. 164, 17th January 1868, No. 352, 1st February 1868, No. 3471, 14th November 1868, and No. 1197, 19th April 1869, and that they comprise many different arrangements of retorts or close kilns for the coking of carbonaceous iron ores—all having this common object, viz. to volatilize and burn off for the purpose, wholly or in part, of effecting the roasting or coking of the volatile parts of the contained carbon compounds, preserving untouched the solid contained carbon, to be burnt afterwards in the blast furnace during the operation of smelting. Amongst the various forms of coking apparatus specified, that which appears to us to look the most hopeful is the arrangement based upon an adaptation of the continuous kiln or oven of Hoffman (or Chamberlain), which has long been in such valuable and economical use for burning brick. The operation of roasting or calcination, prior to smelting, has very long been practised with all iron ores, except red hæmatites and magnetic iron oxide, for which it would be valueless. The objects supposed to be held in view are, to break up the larger masses of the iron into more suitable sizes, to render the whole more porous by the expulsion of volatile matters, and to drive off more or less sulphur, if, as is nearly always the case, sulphides exist in the ore. This, when applied to clay ironstones or carbonates of iron of whatever sort, in the usual way, with free access of air, brings part of the protoxide present to peroxide, partly combined so as to represent the magnetic oxide.

Now, all the protoxide which absorbs an additional equivalent of oxygen requires additional fuel in the blast furnace afterwards to smelt it—in the ratio of 6 by weight of carbon to 8 by weight of the oxygen to be got rid of—and in fact this does not really represent the entire waste of fuel thus introduced as a result of roasting, inasmuch as a larger volume of waste gases arise, the heat carried off by which must be restored at the expense of the solid fuel. In fact, the difference in fuel consumed to the ton of iron, assuming the whole of the one to consist of protoxide, or the entire of it of peroxide, would be about as 87 to 137. But this is not the whole question. We have also to consider what difference peroxidation may have upon the slags of the blast furnace itself; and here the advantage is all on the side of the open kiln roasting or peroxidation, for whilst the protoxide ores eagerly unite with silicic acid, and form basic slags very hard to reduce, the peroxide ores have greatly less affinity for silicic acid at the smelting temperature, and so neither produce as much nor as objectionable a slag. Mr. Aitken professes to eliminate the sulphur if contained in the ores suited to his process by the action of water vapour (or as he states, we think more doubtfully, of salt water) towards the end of the coking, and there cannot be much doubt that some small amount of peroxidation must occur at this stage of the treatment. On the whole, however, this process must be assumed based upon the assumption that in certain classes of clay ironstones rich in hydrocarbons and diffused carbon, it will be better, i.e. more economical,

practice to waive the advantages in a great degree of peroxidation, in favour of saving for use, in the most available ways, these combustible constituents of the ore, in place of practically wasting the larger proportion of them by expulsion or combustion in the roasting kiln. And where clay band iron ores without carbon co-exist in the same works, with black bands rich in carbon and its compounds, the advantage must undoubtedly be the greatest, because the latter may be employed to coke or calcine the former.

Objections have been urged against this process, more especially by Mr. John Gjers, of Middlesboro, in the "Iron and Coal Trades Review," which only in part appear well founded, and to which we think that Mr. Aitken has made a satisfactory reply in the same Journal of September last. As in all like cases of complicated relations, and into which compromises of admitted principles have to be admitted, this process has appeared to us one upon which opinions might be endlessly divided, and with but little advance to a result. We have therefore waited for *such facts* as might admit of a more decisive judgment, and having received some such direct from the inventor, we now lay them before our readers.

Table I. gives the results of working of the same furnace (though not in the same way in all respects) during about a year, first with wholly condensed ones on the old methods, and secondly with about one-third of coked ironstone containing 30 per cent. of diffused carbon substituted.

TABLE I.

## ALMOND IRON WORKS,

NEAR FALKIRK, N.B.

Abstract Statement of Materials used in No. Furnace 2, make of Pig Iron therefrom, and Consumpt per Ton of Iron made.

| | MATERIALS USED. | | | | | | | | | | IRON MADE | | | | | | | | | | | CONSUMPT per TON. | | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coal | | Coke | | Ironstone | | Hematite | | Lime | | No. 1 | | No. 3 | | No. 4 | | Silvery | | White and Mottled | Total | | Coal and Coke computed into coke | | Ironstone & Iron Ore | | Lime | |
| FIRST PERIOD PAY ENDING | tons | cwt. | tons | cwt. | tons | cwt. | tons | cwt. | tons | cwt. | tons | cwt. | tons | cwt. | tons | cwt. | tons | cwt. | tons | tons | cwt. | tons | cwt. | tons | cwt. | cwt. | |
| 3rd April 1867 | 725 | 18 | 418 | 5½ | 1,162 | 17½ | 115 | 7½ | 377 | 13¼ | 52 | 0 | 282 | 0 | 200 | 0 | 112 | 10 | 11 | 657 | 10 | 1 | 3¾ | 1 | 18¾ | 11½ | |
| 1st May „ | 678 | 4½ | 440 | 4 | 1,087 | 3 | 133 | 12½ | 359 | 1½ | 87 | 10 | 347 | 10 | 150 | 10 | 38 | 0 | 27 | 650 | 10 | 1 | 3¾ | 1 | 17½ | 11 | |
| 29th „ „ | 717 | 10 | 470 | 19 | 1,140 | 7½ | 139 | 0 | 338 | 11¼ | 244 | 0 | 337 | 0 | 33 | 10 | 87 | 10 | 0 | 702 | 0 | 1 | 3½ | 1 | 16¼ | 9½ | |
| 26th June „ | 571 | 16½ | 585 | 6 | 1,117 | 12½ | 139 | 0 | 335 | 5 | 191 | 0 | 170 | 0 | 215 | 0 | 12 | 0 | 80 | 668 | 0 | 1 | 6 | 1 | 16¾ | 10 | |
| 24th July „ | 721 | 9½ | 400 | 18 | 953 | 6½ | 104 | 17 | 313 | 9¾ | 237 | 0 | 141 | 10 | 131 | 10 | 30 | 0 | 35 | 575 | 0 | 1 | 6½ | 1 | 26½ | 11 | |
| 21st Aug. „ | 754 | 0 | 435 | 7½ | 1,020 | 14½ | 107 | 10 | 321 | 19 | 198 | 10 | 210 | 10 | 161 | 0 | 7 | 0 | 22 | 599 | 0 | 1 | 7½ | 1 | 18 | 10¾ | |
| 18th Sept. „ | 604 | 16 | 683 | 7 | 1,318 | 0½ | 5 | 10 | 378 | 3 | 359 | 0 | 283 | 0 | 43 | 10 | 0 | 0 | 0 | 685 | 10 | 1 | 9 | 1 | 18¾ | 11 | |
| 16th Oct. „ | 478 | 15½ | 809 | 0 | 1,408 | 1 | 0 | 0 | 402 | 6 | 315 | 0 | 362 | 10 | 25 | 0 | 17 | 10 | 0 | 720 | 0 | 1 | 9 | 1 | 19 | 11¼ | |
| 13th Nov. „ | 563 | 17 | 714 | 7½ | 1,349 | 5 | 0 | 0 | 384 | 5 | 242 | 0 | 377 | 10 | 21 | 10 | 5 | 10 | 58 | 704 | 10 | 1 | 8¼ | 1 | 15½ | 11 | |
| 11th Dec. „ | 891 | 2 | 243 | 7½ | 1,012 | 12 | 0 | 0 | 265 | 2 | 224 | 10 | 116 | 0 | 77 | 10 | 66 | 0 | 37 | 521 | 0 | 1 | 6½ | 1 | 18¾ | 10 | |
| 8th Jan. 1868 | 745 | 16 | 327 | 16 | 1,020 | 7¼ | 0 | 0 | 264 | 12¾ | 128 | 0 | 245 | 0 | 80 | 10 | 62 | 0 | 0 | 515 | 10 | 1 | 7 | 1 | 19¼ | 10¼ | |
| 5th Feb. „ | 835 | 19½ | 438 | 19¼ | 1,364 | 2 | 0 | 0 | 308 | 15½ | 439 | 10 | 135 | 0 | 19 | 10 | 71 | 0 | 0 | 665 | 0 | 1 | 5¾ | 2 | 0½ | 9½ | |
| 4th March „ | 938 | 14 | 493 | 19¼ | 1,510 | 12½ | 0 | 0 | 341 | 5¾ | 277 | 0 | 383 | 10 | 80 | 10 | 12 | 10 | 0 | 753 | 10 | 1 | 5½ | 2 | 0 | 9 | |
| Total and Average . | 9,227 | 18½ | 6,461 | 16½ | 15,465 | 1¾ | 744 | 17 | 4,390 | 9¾ | 2,995 | 0 | 3,391 | 0 | 1,239 | 10 | 521 | 10 | 270 | 8,417 | 0 | 1 | $6\frac{3}{10}$ | 1 | 18½ | 10¼ | |
| SECOND PERIOD PAY ENDING | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 22nd July 1868 | 392 | 4 | 577 | 10½ | 1,572 | 6 | 0 | 0 | 407 | 6¼ | 319 | 10 | 291 | 0 | 32 | 10 | 27 | 10 | 71 | 741 | 10 | 1 | 0¾ | 2 | 2¼ | 10¾ | Of the Ironstone used this pay, 38½ °/o was Coked Ironstone, with about 30 °/o of Fixed Carbon in it. |
| 19th Aug. „ | 816 | 16 | 349 | 2½ | 1,345 | 17 | 0 | 0 | 336 | 9¼ | 346 | 10 | 269 | 0 | 54 | 0 | 0 | 0 | 0 | 669 | 10 | 1 | 2½ | 2 | 0 | 10 | 20¼ °/o Coked Ironstone used this pay same kind as above. |
| 16th Sept. „ | 826 | 4¼ | 319 | 2 | 1,316 | 4 | 0 | 0 | 329 | 1 | 514 | 0 | 128 | 0 | 5 | 0 | 35 | 0 | 0 | 682 | 0 | 1 | 1½ | 1 | 18¼ | 9½ | 24½ °/o „ „ |
| 14th Oct. „ | 852 | 5 | 318 | 5½ | 1,389 | 12 | 0 | 0 | 347 | 8½ | 362 | 10 | 290 | 10 | 0 | 0 | 59 | 10 | 0 | 712 | 10 | 1 | 0¾ | 1 | 19 | 9¼ | 24¾ °/o „ „ |
| 11th Nov. „ | 857 | 3 | 274 | 2¾ | 1,431 | 5 | 0 | 0 | 342 | 3¾ | 549 | 10 | 77 | 10 | 0 | 0 | 45 | 0 | 0 | 672 | 0 | 1 | 0¾ | 2 | 2½ | 10 | 32 °/o „ „ |
| 9th Dec. „ | 850 | 2½ | 261 | 13½ | 1,406 | 5 | 0 | 0 | 307 | 3½ | 531 | 10 | 154 | 0 | 0 | 0 | 0 | 0 | 0 | 685 | 10 | 1 | 0¼ | 2 | 1 | 9 | 30¾ °/o „ „ |
| 6th Jan. 1869 | 689 | 3¼ | 171 | 15½ | 1,312 | 10 | 0 | 0 | 274 | 9¼ | 234 | 10 | 100 | 10 | 0 | 0 | 232 | 0 | 0 | 567 | 0 | 0 | 18 | 2 | 6 | 9¾ | 39½ °/o „ „ |
| 3rd Feb. „ | 612 | 0 | 258 | 18¾ | 1,399 | 1 | 0 | 0 | 300 | 10¼ | 388 | 10 | 133 | 10 | 101 | 10 | 22 | 10 | 0 | 646 | 0 | 0 | 17½ | 2 | 3¼ | 9¼ | 42½ °/o „ „ |
| 3rd Mar. „ | 626 | 16¾ | 410 | 13¼ | 1,450 | 16 | 0 | 0 | 328 | 19 | 287 | 10 | 394 | 10 | 9 | 10 | 21 | 0 | 0 | 712 | 10 | 1 | 2 | 2 | 4½ | 10 | 30¼ °/o „ „ |
| 31st „ „ | 619 | 7 | 417 | 15 | 1,445 | 17 | 0 | 0 | 321 | 8 | 399 | 10 | 180 | 10 | 103 | 0 | 0 | 0 | 0 | 683 | 0 | 1 | 1¼ | 2 | 2¼ | 9½ | 33¼ °/o „ „ |
| 28th April „ | 590 | 2 | 356 | 0 | 1,426 | 15 | 0 | 0 | 312 | 5¾ | 550 | 10 | 123 | 0 | 0 | 0 | 0 | 0 | 0 | 673 | 10 | 0 | 19¼ | 2 | 2¼ | 9¼ | 35¼ °/o „ „ |
| 26th May „ | 591 | 10 | 357 | 4 | 1,438 | 6 | 0 | 0 | 316 | 13¾ | 553 | 0 | 92 | 10 | 23 | 10 | 0 | 0 | 0 | 669 | 0 | 0 | 19½ | 2 | 3 | 9¼ | 36½ °/o „ „ |
| 23rd June „ | 615 | 15 | 379 | 4 | 1,540 | 11 | 0 | 0 | 335 | 13¼ | 510 | 10 | 202 | 0 | 0 | 0 | 0 | 0 | 0 | 712 | 10 | 0 | 19¼ | 2 | 3¼ | 9¼ | 36¼ °/o „ „ |
| Total and Average . | 8,939 | 8¾ | 4,451 | 7¾ | 18,475 | 5 | 0 | 0 | 4,259 | 11½ | 5,547 | 10 | 2,436 | 10 | 329 | 0 | 442 | 10 | 71 | 8,826 | 10 | 1 | 0 | 2 | 1¾ | 9¾ | 32½ °/o „ „ |
| Total and Average | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1st Period . | 9,227 | 18½ | 6,461 | 16½ | 15,465 | 1¾ | 744 | 17 | 4,390 | 9¾ | 2,995 | 0 | 3,391 | 0 | 1,239 | 10 | 521 | 10 | 270 | 8,417 | 0 | 1 | $6\frac{3}{10}$ | 1 | 18½ | 10¼ | |
| 2nd „ . | 8,039 | 8¾ | 4,451 | 7¾ | 18,475 | 5 | 0 | 0 | 4,259 | 11½ | 5,547 | 10 | 2,436 | 10 | 329 | 0 | 442 | 10 | 71 | 8,826 | 10 | 1 | 0 | 2 | 1¾ | 9¾ | 32½ °/o „ „ |
| Increase . | 0 | 0 | 0 | 0 | 3,010 | 3¼ | 0 | 0 | 0 | 0 | 2,552 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 409 | 10 | 0 | 0 | 0 | 3¼ | 0 | |
| Decrease . | 288 | 9¾ | 2,010 | 8¾ | 0 | 0 | 744 | 17 | 130 | 18½ | 0 | 0 | 954 | 10 | 910 | 10 | 79 | 0 | 199 | 0 | 0 | 0 | $6\frac{3}{10}$ | 0 | 0 | 0½ | |

## ABSTRACT.

| | 1st PERIOD. Old Method—All Calcined Stone. Tons. | Cwts. | 2nd PERIOD. New Method—32½ °/o of Coked Stone used. Tons. | Cwts. |
|---|---|---|---|---|
| Coal | 9,227 | 18½ | 8,939 | 8¾ |
| Coke | 6,461 | 16½ | 4,451 | 7¾ |
| Ironstone and Hematite | 16,209 | 18¾ | 18,475 | 5 |
| Lime | 4,390 | 9¾ | 4,259 | 11½ |
| No. 1 Pigs made | 2,295 | 0 | 5,547 | 10 |
| No. 3 „ | 3,391 | 0 | 2,436 | 10 |
| No. 4 „ | 1,239 | 10 | 329 | 0 |

| | 1st PERIOD. Old Method—All Calcined Stone. Tons. | Cwts. | 2nd PERIOD. New Method—32½ °/o of Coked Stone used. Tons. | Cwts. |
|---|---|---|---|---|
| Silvery Pigs made | 521 | 10 | 442 | 10 |
| White and Mottled do. | 270 | 0 | 71 | 0 |
| Total Make | 8,417 | 0 | 8,826 | 10 |
| AVERAGES PER TON OF PIGS. | | | | |
| Coal and Coke Compnted into Coke | 1 | $6\frac{3}{10}$ | 1 | 0 |
| Ironstone and Iron Ore | 1 | 18½ | 2 | 1¾ |
| Limestone | 0 | 10¼ | 0 | 9¾ |

No. 2 Furnace is 48 feet high.
16 feet in diameter at Boshes when new.
6 feet in diameter at Hearth when new.
7 twyers with nozzles from 2½" to 3" diameter.

2½ to 3lb. pressure of blast per square inch.
12 twyers used First Period.
14 twyers used Second Period.

NOTE that no Hematite was used dnring the Second Period. The actual increase in Second Period of Ironstone and Iron Ore nsed was thus only 2.265 tons, 6¼ cwt.

These results show unquestionably (and we presume the data fully reliable) a very appreciable saving of fuel (coal or coke) per ton of iron made; also an increase in the total yield of iron, an improvement in the average quality, *i.e.* in the number or brand, and a diminution in the proportion of limestone.

The *total* fuel per ton of iron is not completely given, however, for during the "second period" the furnace was worked with 14 twyers in place of 12, and at the same pressure apparently in both cases, so that rather more fuel must have been consumed for blast, which we do not understand to have been produced merely by waste gases; this addition, however, can be but small.

The iron-stones used during the "second period," we learn from Mr. Aitken, consisted of—

| | |
|---|---|
| Clay band or argillaceous ironstones of difficult fusibility | 45 per cent. |
| Coked black band holding 30 per cent. of carbon | 32 „ |
| Mussel band and black band calcined in the usual way with 5 per cent. of good argillaceous ironstone mixed | 23 „ |
| | 100 per cent. |

The clay band we understand to have been not calcined. The following was the content in ash of the fuel:—

| | |
|---|---|
| Coal | 5 to 7 per cent. |
| Coke | 10 to 14 „ |

We also subjoin analyses by the late Dr. Penny, of Glasgow, of the ores employed, and the limestone :—

No. 1.—Parkside Hematite used at Almond Iron Works, 1867.

| | |
|---|---|
| Peroxide of iron | 98·26 |
| Silica | 1·59 |
| Phosphate of iron | ·30 |
| Lime and magnesia | traces |
| | 100·15 |
| Metallic iron in peroxide | 68·782 |

No. 2.—Common grey clay band stone from Nos. 4, 7, 8, and 12 seams Boghead, used at Almond Iron Works in 1866, 1867, 1868, and 1869.

| | |
|---|---|
| Protoxide of iron | 44·35 |
| Peroxide of iron | trace |
| Lime | ·67 |
| Magnesia | ·43 |
| Alumina | 7·00 |
| Silica | 12·40 |
| Phosphates | 1·42 |
| Coaly matter | 4·20 |
| Water | ·40 |
| Carbonic acid | 28·00 |
| | 98·87 |
| Iron | 34·50 |

No. 3.—Black band ironstone used at Almond Iron Works, 1868 and 1869.

| | |
|---|---|
| Metallic iron | 16·23 |
| Protoxide of iron | 36·29 |
| Sesquioxide of iron | traces |
| Sulphide of iron | 2·09 |
| Lime | 1·07 |
| Magnesia | 2·50 |
| Phosphates, &c. | 3·63 |
| Silica and clay | 8·00 |
| Fixed carbon | 27·20 |
| Water | 2·60 |
| Volatile matters | none |
| | 99·61 |
| Iron in the metallic state | 16·23 |
| Iron as protoxide | 28·06 |
| Iron as sulphide | 1·33 |
| Total iron | 45·62 |

No. 4.—Limestone used at Almond Iron Works.

| | |
|---|---|
| Protoxide of iron | ·18 |
| Lime | 54·25 |
| Magnesia | ·50 |
| Phosphates | ·41 |
| Coaly matter | ·24 |
| Silica and clay | ·82 |
| Moisture | ·20 |
| Carbonic acid | 43·40 |
| | 100·00 |

As respects the disadvantages of the basic character of the slags, Mr. Aitken states that analyses of these show that they are *not* richer in iron than by the old method. If that be so, as the total quantity of limestone employed is *less* than with the old or ordinary mode of working, it is plain that no loss can be sustained here; we regret that we have not yet received any analysis of these slags.

That a part of Mr. Aitken's method consists in working the blast-furnace itself with a freer blast, and *possibly* at a higher temperature, is also obvious. In a circular before us, of August last, Mr. Aitken explains that the reason why he limited the furnace feed to 32½ per cent. of *coked* black band was simply that his limited supply of black band, rich in carbon, admitted of his employing no larger proportion. With apparatus as yet, the patentee states, inadequate, and by no means the best possible for fully economising the heat derived from the volatile hydrocarbons of the black band, the cost of coking is but 2*d.* per ton. It would be much less when operating upon a great scale, and fully utilising the heat derivable, either for calcining other or argillaceous ores, or for raising steam, &c. We should also have wished for more precise information as to the content of sulphur in several numbers of pig iron made under this method, for Mr. Aitken's proposed methods of separating the sulphides in coking appear to us so far the most dubious part of his operations, and the analysis of the coked black band, No. 3, shows rather more than 2 per cent. of sulphide of iron still remaining in the ore. It does not follow, however, that its sulphur must remain, all of it, in the reduced metal.

Upon the whole, here is a year's working—not upon the fully developed plan, *i.e.* with nothing but coked ore employed—before us, and as the "proof of the pudding is in the eating," we think we are justified in pronouncing that this process, of which at its earliest promulgation we confess we did not much esteem, contains the elements of a decisive advance, though a great deal more remains to be done before its relations can be said to have been fully ascertained, and the limits of its advantages (or possible disadvantages) fixed.

## THE GUNBOAT *STAUNCH.*

(*Illustrated by Plate* XVI.)

The gunboat *Staunch*, built from the designs of Mr. Rendell, of the Elswick Company's Works, presents many striking features, and as she has passed successfully through a series of trials at Portsmouth, and is likely to prove the forerunner of a fleet of small vessels specially suited for harbour defence, we may be permitted to give a few particulars of her construction, &c. The most striking feature in this vessel is her moderate size as compared with the weight of the gun she carries. She is only 70 feet long, 25 feet broad, and has a mean draught of 6 feet 4¾ inches, with a burden of 200 tons, yet she carries a 12½-ton gun and a fair supply of ammunition. In fact, she is a floating gun-platform, which can be driven at a speed of about 7·65 knots by her twin-screw engines of 25 horse-power nominal, and can be very rapidly manœuvred. The heavy gun is carried well forward—about 10 feet from the bow—and, when in action, the platform on which it stands is at the level of the upper deck, about 2 feet 9 inches above water. When not in action, the gun and its platform are lowered into a *well* constructed for the purpose, and the upper part of the gun comes just below the deck-height, so that hatches can be shipped above it and all made snug. This is obviously a great advantage, since the rolling motion of the little vessel cannot but be decreased when the heavy gun is thus lowered. A small auxiliary engine is fitted for the purpose of raising and lowering the gun, and this is necessary, as the weight to be

moved is not much less than 17 tons. It should be added that the gun cannot be trained upon its supports; all training has to be given by manœuvring the vessel herself, a matter of great ease, since she has twin screws, and is of such small size. In order to bear the explosion of this heavy gun successfully, as well as to carry the proportionately heavy weights of machinery, ammunition, &c., the hull is built of iron. Of course, there is no attempt at armour on any part, for though the gun is worked from behind a screen, that is of the slightest construction, and would only suffice to protect the men from rifle-shots or to keep back the water when in a moderate sea. Being so low in the water, however, and so small, the chance of such a vessel being hit, especially when in motion, is very small indeed; but with her manœuvring power, her heavy gun, and small draught of water, she would doubtless prove a formidable antagonist to any ship trying to force a passage up a harbour where she might be stationed, particularly when supported by land fortifications. Being specially intended for harbour service, the *Staunch* will have only a small crew, sufficient to work and fight her. On this account only a small amount of accommodation is required inboard, and the hold-space is nearly all occupied by magazines, engine-rooms, gun-well, stoke-hole, &c. On the whole, the opinion has been formed by competent persons that for the service intended, small and cheap vessels of the *Staunch* class are the best possible, although their usefulness is comparatively limited. The steering of the *Staunch* was somewhat defective, but this defect, with some others of minor importance, will be remedied in the new vessels of this class which the Admiralty are about to build.

## SAFETY-LOCKING SWITCH AND INTERLOCKING SIGNAL APPARATUS FOR RAILWAYS.

Mr. John Brunton, M.I.C.E., has recently introduced some important improvements in the mode of actuating and locking railway switches, and of interlocking the points and signals on railways, which we have much pleasure in laying before our readers.

The objects to be attained by Mr. Brunton's improvements are as follows:—

First—That the switch or point, when either completely opened or closed, shall be so fixed in its position that the vibration of the passing trains, even at high velocities, shall have no tendency or power to alter such position, and thereby either throw the passing vehicle off the line of rails or cause unpleasant and injurious jolting.

Fig. 2.

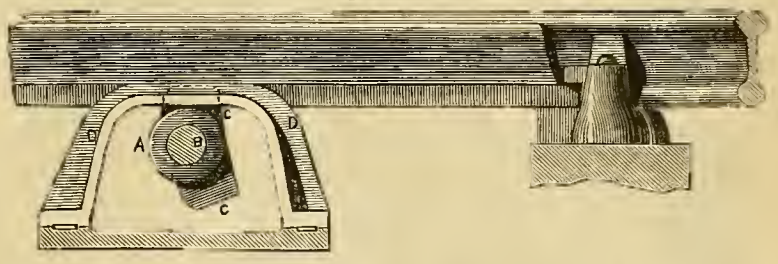



Fig. 1 of the engravings represents a transverse section of the apparatus for actuating and locking the switches combined with the interlocking apparatus for the points and signals.

Fig. 2 is an inside elevation of one end of the switch rail. Figs. 3 and 4 are enlarged views of the cams and locking-pieces, or blocks, for actuating and locking the switches. Figs. 5 and 6 represent the interlocking mechanism for the points and signals in elevation in two positions, and fig. 7 is a plan corresponding to

Fig. 3. Fig 4.

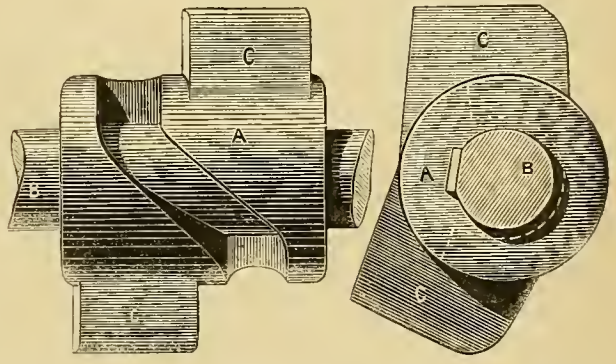
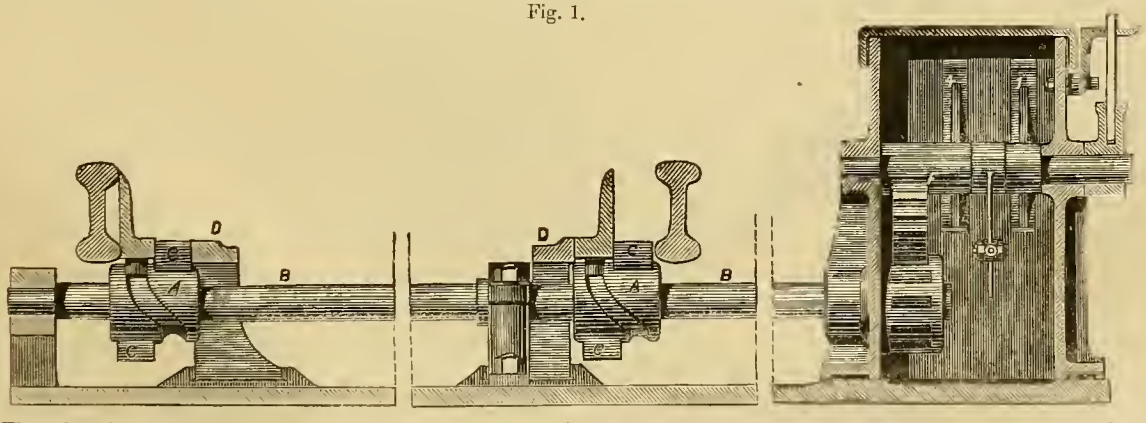



fig. 5. The switch point, or moveable rail, is provided with a projecting stud on its underside, carrying an anti-friction roller or not, as preferred, which works in a spiral groove formed in a cylindrical scroll cam A, mounted upon a rocking shaft or spindle B, which is placed transversely to the line of rails, and is actuated by a lever or other convenient arrangement of mechanism. The two extremities of the spiral groove terminate in a straight portion

Fig. 1.




Second—That the signals indicating the position of the points shall be so arranged that it is out of the power of the pointsman to make any error, such as showing "main line clear," whilst his points are open to the siding or branch, and *vice versâ*.

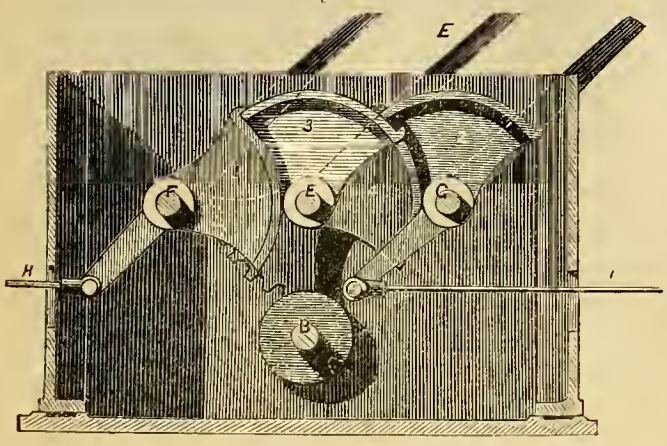
Third—That the arrangement of the signalling and points-locking apparatus shall be such that each of the three movements necessary for the whole operation, viz., blocking the main line, moving the points, and opening the siding or branch, or *vice versâ*, must be complete before the next movement can be made, and that the order or rotation of these movements cannot be interfered with by any carelessness on the part of the pointsman.

made directly in the path of rotation of the cam, and consequently imparting no motion to the switch, point, or moveable rail, when its projecting stud enters therein.

Upon the periphery of the cam, and parallel with the two straight portions of the groove, are provided wedge-pieces or blocks, c c, which project some distance from the surface of the cylindrical body of the cam and bear against one side of the switch when in

its open or closed position, thereby effectually locking it in its place—a bridge-piece, D, serving as the abutment of the switch when open, and the side of the main rail as the abutment when shut. When using a moveable rail, a special abutment will be provided for both ends of its traverse. By making a portion of the groove straight or in the direction of the circumference of the cam at each

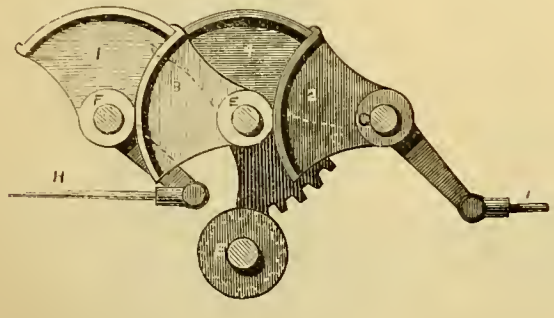
Fig. 5.




end, the cam is permitted to rotate sufficiently to allow of the wedge-pieces being brought into or out of action before the switch, point, or moveable rail begins to move, or after it has been driven home by the cam. In order to prevent the accidental lifting or rising of the end of the switch, a T-headed stud or guide pin may be fixed thereto and work in a correspondingly shaped curved groove in the base plate. Or the toe of the switch may be extended on the lower side, as shown in fig. 2, and work in a horizontal groove specially provided in the base of the chair.

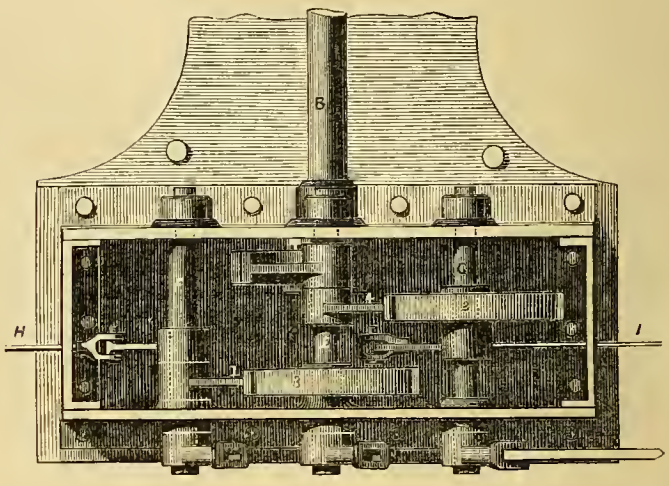
The movement of the switches may be accomplished in the ordinary manner, in lieu of by a cam groove as described, and the switches may then be locked or fixed in position by the aid of the wedge-pieces or blocks, C C, which, in that case, would be carried on plain bosses on the transverse rocking shaft B. This rocking shaft may be actuated either by a lever handle attached directly thereto, or it may derive its motion from the subsidiary shaft E, on which the point lever E′ is mounted, such subsidiary shaft carrying a toothed segment which gears into a pinion fast on the shaft B. By this arrangement, the arc through which the point lever has to move will be considerably reduced. The subsidiary shaft E is carried in bearings in the sides of a closed box, which also contains the mechanism for actuating the main line and branch or siding

Fig. 6.




signals, and for interlocking such mechanism with the points actuating mechanism. F is the shaft for actuating the main line signal, and G is a similar shaft for actuating the branch or siding signal. These shafts are worked by lever handles, and carry short lever arms, which are connected to the signal rods or wires H and I. On each of the two shafts, F and G, there is mounted a sector 1, 2, and on the subsidiary shaft E there are mounted two sectors 3 and 4. The sectors of 1 and 3 are in the same plane, and interlock the one with the other, whilst the sectors 2 and 4 are in another plane, and also interlock the one with the other. When the several sectors are in the position, shown more clearly in fig. 5, it is obvious that the sector 1 will prevent the sector 3 from moving, since its periphery bears against the end of the sector 3, whilst the sector 4 locks in the same manner the sector 2. Consequently, until the shaft F and its sector 1 have been turned to their full extent by the signal lever, as shown in fig. 6, in order to block the main line, the points which are worked from the shaft E cannot be moved, neither can the signal for the branch or siding be actuated, since the periphery of the sector 4, by bearing against the end of the sector 2, effectually locks the shaft G. So soon, however, as the sector 1 has been

Fig. 7.




turned full over, blocking the main line, as seen in fig. 6, then the sector 3 is free to move and locks the sector 1, by bringing its periphery against the opposite end of that sector. This movement of the sector 3, keyed on the shaft E, opens or closes the points and unlocks at the same time the sector 2, which allows of the branch signal being actuated, but not until the points have been fully opened or shut and wedged or locked, whereupon the several sectors will assume the positions indicated in fig. 6. In figs. 5 and 7 the sectors are in the position they assume when the points are open to the branch or siding, the main line being blocked and the branch signal showing line clear, but in fig. 6 the points are closed to the branch or siding, the main line signal showing "line clear," whilst the branch line is blocked by the branch signal. A small raised lug or projection is formed on one end of each sector to serve as a stop, by coming in contact with the surface or periphery of the corresponding sector.

Our engravings merely show the principle of Mr. Brunton's arrangement in its simplest form; in its application, the details may be modified to suit any kind of rail, and any peculiarity in the position of the pointsman's box, and further in practical application the whole of the working parts are boxed in and are supported on two sleepers near the point of the switches, every part being of such strength and solidity as to secure the immobility of the point of the switch when trains are passing.

We understand that several sets of Mr. Brunton's improved apparatus are in course of construction by Messrs. Ransomes and Rapier for both English and Indian railways.

## THE PRIORITY OF INVENTION IN HYDRAULIC CONNECTORS AND MACHINERY FOR THE TRANSFER BY WATER OF POWER AND MOTION.

Hydraulic machinery for the transfer of power by water pressure, whether for hoisting or other analogous purposes, or for producing rotation like other first motors, has within the last twenty years, or thereabouts, assumed a most important position amongst applied and valued mechanical arrangements.

Although a great deal more was done in perfecting durable and efficient water-pressure engines, upon a very large scale in some instances, long prior to the commencement of the above epoch, in Hungary, Saxony, France, and in England by John Taylor & Sons, than is commonly known, still it is undeniable that the present very complete position in which the design and manufacture, as a great trade, of such water-pressure machinery is found, has mainly resulted from the skill and perseverance of Sir William Armstrong, and of his engineering assistants at Elswick.

And so great have been the practical improvements in judicious design and skilful adaptation of parts to meet the difficulties which beset the use of an almost incompressible liquid moving under great pressures, and requiring to be suddenly arrested, that the hydraulic machinery of to-day, and, indeed, as it has been delivered from Elswick Works for a long time past, has every just right to be viewed and its merits adjudged as a new mechanical creation.

To have been the chief creator of this, then, is the merit, and the very high merit, which belongs to Sir William Armstrong ; and we were personally never more struck with evidence of his genuine mechanical ability, as evidenced in these machines, than when, upon a somewhat recent visit to the Allenhead Lead Mines, Cumberland, we stood beside a two-cylindered water-pressure engine, employed in "winding," which we found working under heavy pressure as silently and free from jar as a clock, and which had been constructed by Mr. Armstrong nineteen years ago, and, as we were assured by Mr. Sopwith, F.G.S., had never been repaired, except as to new packing, during that long period of almost constant work.

Several descriptive accounts of these hydraulic machines, their principles, parts, adaptations, and applications, have been contributed to engineering literature, and printed in the "Proceedings of the Institution of Civil Engineers," or in those of the Mechanical Engineers and elsewhere, some from the pen or under the direction of Sir William Armstrong himself.

In all of these the reader who is really acquainted with the history of the subject observes, with some surprise and regret, that tacitly, at least, the *original invention* of transmission of power by hydraulic connection is assumed as that of Sir William Armstrong. This is neither graceful nor just to the name and reputation of one of the greatest mechanical geniuses ever produced in this or any other country—of Joseph Bramah, whose memory is enshrined in the well-known Hydrostatic (as he called it) Press, which he invented ; for it was Bramah that, at the very commencement of this century, invented and worked out the whole idea of water-pressure machinery. The fact that Bramah had fully realised in his thoughts, the largest extent to which water-pressure transfer of power ever has since been brought, as early as 1802 (and, doubtless, prior to that), was authenticated the year before last, by the presentation to the meeting of the Institution of Mechanical Engineers at Birmingham, in 1868, of an original letter addressed by Joseph Bramah to Robert, the grandfather of the present Mr. R. Mallet, who was in business connection, as he had previously been fellow-apprentice with Bramah. The letter, of which photograph copies were distributed to the members, is dated London, 10 Nov. 1802, and the following extract establishes the point. Bramah writes:—

"I have also now applied it (the hydraulic press), with the most surprising effect, to every sort of crane for raising and lowering goods into and out of warehouses.

"So complete is the device, that I will engage to erect a steam-engine in any part of Dublin, and from it convey motion and power to all the cranes on the keys (quays), and elsewhere, by which goods of any weight may be raised at one-third of the usual cost. This I do by the simple communication of a pipe, just the same as I should do to supply such premises with water.

"I have a crane on my own premises (viz. at Pimlico) which astonishes every person to whom it has been shown, as they see the goods ascend and descend 15 or 20 times in a minute to the height of 18 or 20 feet, and at the same time it is impossible for any person unacquainted with the principle to discover how or where the power comes from."

Bramah's patent for these hydraulic cranes discloses, in fact, the very contrivances for altering range in relation to power in the water cylinder which have been since universally adopted. This sets at rest *the fact, as well as the extent of priority*, which must be awarded to Bramah. The *accumulator*, however, appears to have been an introduction posterior to his time, and the first introduction of this has been very commonly attributed to Sir W. Armstrong, and in that view we ourselves were participators until very recently. We have, however, now before us facts which appear to prove that this too was anticipated, and that "the accumulator" is an invention as old as 1818, at least. In this instance, however, we are unfortunately not able to award the merit where it really belongs, for the inventor, as referred to in the following extracts, remains personally unknown.

[*Extract from the "Glasgow Mechanics' Magazine, and Annals of Philosophy," of Saturday, 3rd January* 1824.]

Description of the Great Bandana Gallery in the Turkey Red Factory of Messrs. Monteith & Co., at Glasgow. (Abridged from an article in the *Journal of Sciences*, by Dr. Ure.)

Their new arrangement of hydrostatic presses was completed in 1818, under the direction of Mr. George Rodger, senior manager of the works. It consists of sixteen of these engines, beautifully constructed, placed in one range, in sub-divisions of four, the space between each set serving as passages to admit workmen readily to the back of each press. Each sub-division occupies twenty-five feet, whence the total length of the apparatus is 100 feet.

To each is attached a pair of patterns in lead (or *plates* as they are called), the manner of forming which will be afterwards described. One of these plates is fixed to the upper block of the press; this block is so contrived that it turns on a kind of universal joint which enables this plate to apply more exactly to the under plate. The latter rests on the movable part of the press, commonly called the *sill*. When this is forced up the two patterns close on each other very nicely by means of guide-pins at the corners, fitted with the utmost care. The power which impels this great hydrostatic range is placed in a separate apartment, called the "machinery room." This machinery consists of two cylinders of a peculiar construction, having cylindric pistons accurately fitted to them. To each of these cylinders three little force pumps, worked by a steam-engine, are connected. The piston of the larger cylinder is eight inches in diameter, and is loaded with a top weight of five tons. This piston can be made to rise about two feet through a leather stuffing or collar. The other cylinder has a piston of only one inch in diameter, which is also loaded with a top weight of five tons. It is capable, like the other, of being raised two feet through its collar.

Supposing the pistons to be at their lowest points, four of the six small force-pumps are put in action by the steam-engine, two of them to raise the large piston, and two the little one. In a short time so much water is injected into the cylinders that the loaded pistons have arrived at their highest points—they are now ready for working the hydrostatic discharge presses, the water pressure being conveyed from the one apartment to the other underground, through strong copper tubes of small calibre. Two valves are attached to each press, one opening a communication between the large *prime cylinder* and the cylinder of the press, the other between the small *prime cylinder* and the press. The function of the first is simply to lift the under block of the press into contact with the upper block, that of the second is to give the requisite compression to the cloth. A third valve is attached to the press for the purpose of discharging the water from its cylinder; when the press is to be released, in order to remove or draw through the cloth.

While thus it is evident that the original inventorship of no part of the system of water-pressure transmission of power appertains to Sir William Armstrong, his merits as a mechanical engineer, in having made its details *literally perfect*, are great.

Bramah's invention was far in advance of his period. Time brought the demand for the machinery which his successor, with great insight, saw the importance and inherent value of, and by his skill has left it in its present state, an heirloom to mankind.

And the success is an encouraging example for all who with such discernment, with skill and perseverance, shall choose and work out an old invention.

## KILNS.

Mr. Jonathan Mitchell, of Bradford, has recently patented some improvements in kilns for burning bricks, lime, and articles of earthenware.

His invention relates to arched kilns, and consists in a new combination and arrangement of the flues and dampers thereof. Any convenient number of fire-places may be employed, which may be set at equal distances along both sides of the kilns ; between the fire-places dampers are provided, connected to flues running on the outside of the kiln.

Fig. 1 of the engravings represents a longitudinal section of a portion of the improved kiln, taken along the line 1–2 (fig. 3), so as to show the hot-air flues, which are built inside the side walls of the kiln. Fig. 2 is a longitudinal vertical section taken along the line3–4 (fig. 3), showing the several chambers, and a central return flue, which connects the first and last of the series of chambers. Fig. 3 is a horizontal section, one portion being taken along the line 5–6 (fig. 5), so as to show the hot-air flues, and the other portion along the lines 7–8 (fig. 5). Fig. 4 is a transverse vertical section taken along the line 9–10 (fig. 1), showing the passages communicating with the external chimney-flues ; and fig. 5 is a similar view, taken along the line 11–12, showing the hot-air flues. A A are the external walls of the kiln, which may be of any desired length ; it is provided with an arched roof B, and is subdivided by permanent division walls C C into any convenient number of chambers —say, for example, six (numbered respectively in the engravings from 1 to 6). Each chamber is provided with two fire-places *a a*, one on each side, and openings *b b* are made in the division walls for enabling the heat and products of combustion to pass freely from one chamber to another. These openings are provided with dampers *c c*, worked by weights and pulleys from the outside of the top of the kiln, for the purpose of opening or closing the communication as required. D D are lateral descending flues, two of which lead from each chamber, and carry off the smoke or vapour into the two external chimney-flues E E, communicating directly with the chimney F. The flues D are each provided with dampers *d d*, worked from the outside. G G are lateral hot-air flues, two of which lead from each chamber into the main hot-air flues H H, and also into the external chimney-flues E E running longitudinally along the side walls A ; which flues pass forward the heat to any

Fig. 1.

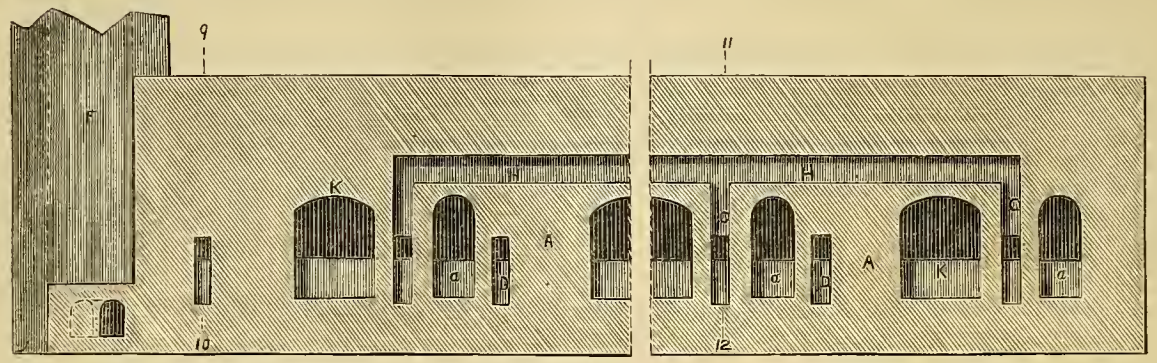



Fig. 2.

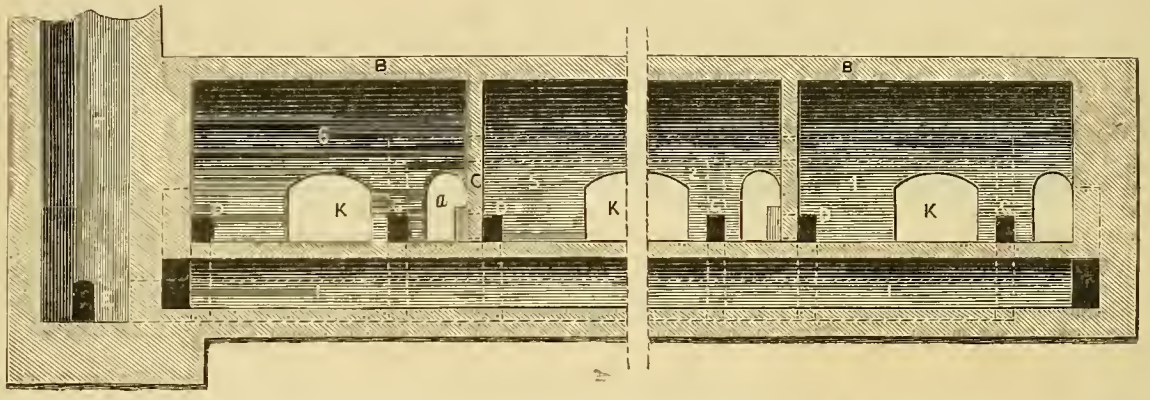
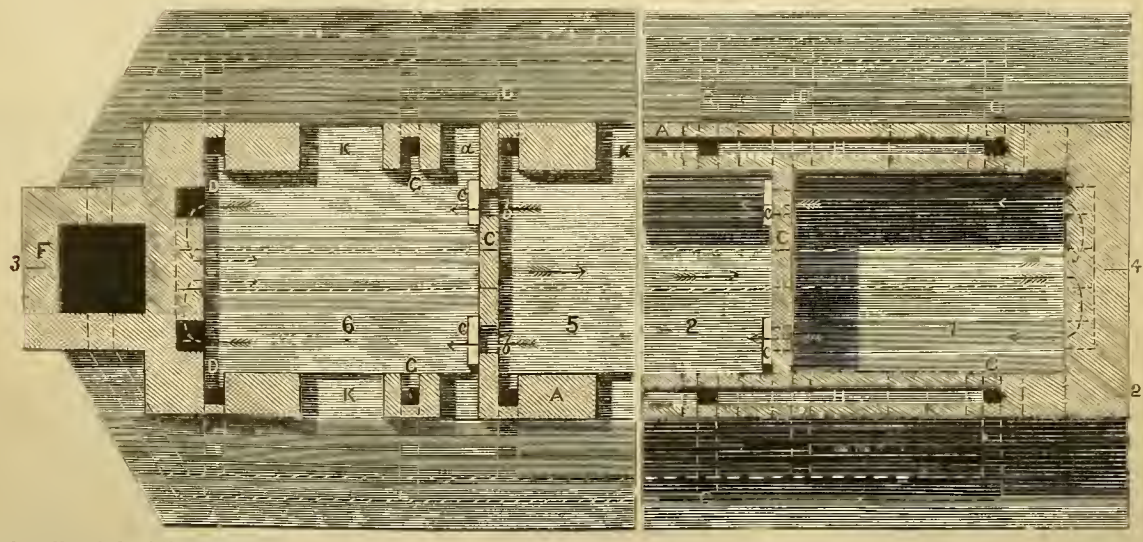
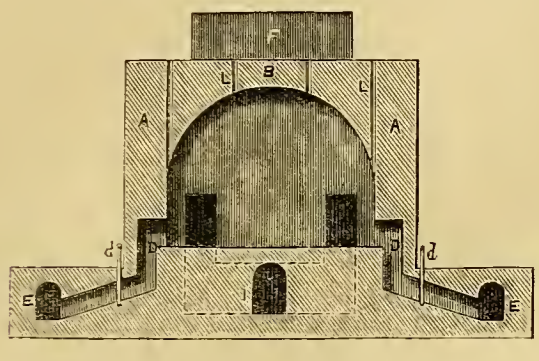



Fig. 3.



other chamber, in order to dry the green bricks stacked ready for being burnt, or to cool down the bricks in the chambers after being burnt. Any of the chambers may be thus brought into communication through the hot-air flues, by opening the hot-air dampers *e e*

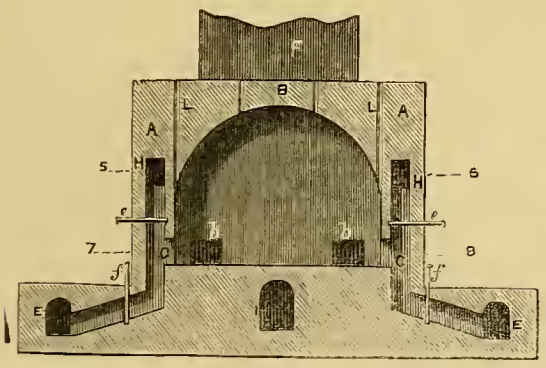
Fig. 4.




provided for that purpose, and worked from the outside. I is a central return-flue for carrying the whole or a portion of the heat back from the last to the first chamber of the series, as shown by the arrows. K K are the side entrances to each chamber, and L L are the firing-holes in the roof, through which fuel in a fine state of division is introduced into and amongst the bricks or other articles or substances whilst being burnt.

When the bricks are stacked ready for burning in No. 1 chamber, it is fired, and two, three, or four dampers, as the case may be, are

Fig. 5.




opened so as to communicate with the outside chimney-flues, to carry off the smoke and vapour, and when these are got rid of these dampers are again closed, and the two dampers *c c* in the division wall communicating with No. 2 chamber are opened, and the dampers *d d* and *f f* in the chamber are then closed, making a communication thereby with the main chimney-flues E E, the dampers *d e* and *f* fn No. 1 chamber being also closed. When No. 1 chamber is burnt off, the two dampers *c c* in the division wall are closed, and the two dampers *e e*, communicating with the hot-air flues above, are opened, to cool down the bricks and pass the heat forward into another chamber, wherein are green bricks stacked for burning, and so on alternately. By this system of flues and dampers the heat is so beneficially applied that it will burn off the six chambers in a week.

## PHILOSOPHICAL SOCIETY OF GLASGOW, Dec. 1, 1869.

*On Patents for Inventions.*—Read by request of the President and Council of the Philosophical Society of Glasgow, by St. John Vincent Day, C.E., F.R.S.E., M. Inst. M.E., &c.

We publish the following abstract of Mr. Day's paper recently read before the Philosophical Society of Glasgow on the inauguration by that body of a discussion on Patents, which was continued throughout three evenings. As it was felt the subject merited such wide and general attention in a large manufacturing centre like Glasgow, the meetings were made public, and not, as usual, limited to the members. The point made in the discussion was the eliciting of a speech from the abolitionist chief Mr. R. A. Macfie, M.P. : it is perhaps the most singular specimen of confused thought and emptiness of fact, coupled with misstatements and innumerable unsound fancies, which has, so far, appeared; and unless the abolitionist has something far more cogent in kind to wage his warfare with than the contents of Mr. Macfie's speech, inventors and those who contend for patent property have little to fear. Mr. Macfie and the abolitionists in general were overwhelmed by the speeches of some eminent inventors, engineers, chemists, manufacturers, and patentees.

Mr. President and Gentlemen,—Before proceeding to the essential points of this Paper, I have a duty first to fulfil, namely, to make my personal acknowledgments to the President and Council of this Society for the honour which I feel is done to myself on this occasion, by being selected to address you on the very important subject we have met to discuss; a subject which throughout the country, and not in Glasgow alone, is deservedly attracting around itself grave consideration —that of "Patents for Inventions."

I may probably be excused for prefacing what I have to say, by at first frankly exposing the existence of some distrust in myself in venturing to treat briefly a matter at once so vast and equally serious—a matter which, in order to submit it to an exhaustive examination, would need our closest deliberation, from so many points of view, through several successive meetings ; and I therefore can for some reasons only wish that, in making choice of a speaker, your selection had fallen on some one having more confidence in himself than I possess, to discharge the duty now taken in hand. Yet, although I have undertaken to say this much, it would ill become me if I did not further add, that upon whomsoever else your selection might have devolved, you would not have met with any one more willing to do his utmost for the cause we have espoused.

On examining the records of this Society, I find that the subject which we have to consider is by no means new to many of the older members ; it has on more than one occasion been before you, and as late as the year 1863, when, in reply to several questions addressed to the Society by the Chamber of Commerce of this city, and to that body by the Royal Commission which sat from 1862 to 1864, a Committee was appointed to deal with the questions, and it sent in replies suggesting what the members then thought would improve the existing state of matters with regard to Patents ; this being for myself somewhat fortunate, for on that account, and owing also to the broad discussion of late in the public press, it will suffice to put certain considerations in a briefer way, than if I had had the more complete task of leading up your minds to what we have to deal with, by commencing at the foundation, and through progressive steps rising up to the summit of the edifice as it now stands.

I deem it necessary to say a few words at the beginning as to the origin of Patents for Inventions, for this will in the speediest way enable us to clearly grasp the true spirit of such grants. Patents for Inventions constituted one link in the chain of privileges of monopoly which the Crown, from ancient times, enjoyed the prerogative of bestowing on any of its subjects, and this right of the Crown was exercised, we know certainly, as long ago as the period of the early Tudor sovereigns ; but in the reign of Elizabeth, the royal privilege was so grossly abused that the state policy and right of the Crown in this respect was disputed.* The action which the Queen herself then carried out in cancelling the obnoxious monopolies, and the satisfaction which she thus afforded the nation, is so well known that I need not dwell on it. It is, however, most important in our present considerations to bear in mind, that not against monopoly in the exclusive right conferred by Patents for Inventions was the public voice clamorous—indeed, it is only during the last few years of our own time that the policy of such grants has been questioned—but against monopolies and exclusive privileges for special trades, and by which grievous injury was done ; indeed, the national policy, to say nothing of the individual advantages of granting Patents for Inventions, has always been most powerfully upheld.

*"It appears from the speeches made on this occasion, that an excessive public grievance then existed, from the multiplication of letters patent for monopolies of almost every branch of trade and manufacture. The following were mentioned, amongst others: salt, aqua-vitæ, vinegar, alegar, train-oil, oil of blubber, brushes, bottles, pouldavy, oade, starch, Irish yarn, calf skins and felts, steel, leather, cards, glasses, saltpetre,[1] &c. &c. There was very little difference of opinion as to the grievances, for each speaker cited some from his own knowledge; but as to the remedy, they debated whether it should be by bill, or by petition to her Majesty : the latter was adopted.

"The following is an extract from the speech of Mr. Francis Bacon, the attorney-general (afterwards Lord Chancellor Verulam). 'The Queen, by her prerogative, 'has both an enlarging and restraining power, for she may set at liberty things 'restrained by statute law, or otherwise, or she may restrain things which be at

[1] The saltpetre patent appears to have been a public nuisance, as it gave a power of entering into any private house, cellar, stable, or other place where the nitrous matter could be gathered, and to dig or carry away without limitation ; and that power appears to have been grossly abused. Royal or Imperial rights, delegated or farmed often to individuals, to search for and obtain saltpetre, as necessary to the *ultima ratio regum*, was existent long before patents were known, and under the title of the "*Saltpetre Regale*" formed a most oppressive burden over a great part of Europe in the middle ages.

In the succeeding reign of James I., the Royal favour was again so grossly abused and unduly exercised, that, in 1623, the Parliament which then met demanded from the King that all monopolies established by royal authority should be null and void; and such was the effect of the representation of the House of Commons then sitting, that the King was forced to consent—the result being the passing of a celebrated measure, commonly known as "The Statute of Monopolies," in the twenty-first year of James I. This statute enacted that all monopolies, grants, and letters patent, for the sole *buying, selling, making, working,* or *using* of anything within the realm, were contrary to the laws and void; but whilst most stringent in other respects, it excepted all letters patent and grants of privilege for the term of twenty-one years then existing, and those for fourteen years or under thereafter to be made, "for the sole working or making of any manner of new manufactures within the realm to the true and first inventor and inventors of such manufactures, which others at the time of making such letters patent and grants should not use, so as also they *be not contrary to the law nor mischievous to the State, by raising prices of commodities at home, or hurt of trade, or generally inconvenient.*"

Nothing can be clearer than the last words of the foregoing clause, that the framers of the statute had in view the overthrow, for all time to come, of all those patents which at the time were in existence, or might afterwards be granted; also, the refusal to sanction any subsequently applied for, which in any way were or might be productive of harm, either individually or nationally, which were not new, or were applied for by some other or others than the "first and true inventor." A careful investigation, too, of the clause further develops the underlying contingency—that in order to create such monopolies in no inventions but what were absolutely novel and advantageous, and to no other than the first and true inventor, the necessity was involved, prior to making the grant, of instituting a stringent scrutiny of all such applications for the exclusive privilege of a patent. Whilst, then, this was the true spirit or essence of the statute, yet it was imperfect, in that no provision was made for the proper examination of the applications prior to the letters patent being allowed; indeed, so imperfect was the provision for carrying out the true spirit of the law, and in practice so far was it from being acted up to, that the State was usually kept in entire ignorance of the true nature of what the applicant's alleged invention really was, as proved by the fact that the first specification enrolled bears date as late as October 3, 1711.* This defect, then, led the way to disputes as to the validity of several patents, and hence patent litigation became established, because it was the only course sanctioned by the Legislature by which the genuineness of the invention and its novelty at the time of making the grant, according to the spirit of the statute, could be determined. Another result of this great oversight of the framers of the statute has been that, from time to time, numerous deceptive and positively obnoxious patents have been and still continue to be granted; it is a fact that not only are letters patent granted for the same thing over and over again, but frequently for the most absurd and impracticable projects; and, what is even worse, numerous patents are every year granted which infringe existing rights, which infringe unexpired patents in many cases for precisely the same thing. In illustration of this, I could point you to one or two notorious instances without going far from these walls. Nor is this avoidable, without a strict examination into the specification and claims of every patent before it is allowed.

Since the passing of the first statute on which letters patent for inventions are based, the law has been several times amended, and held to extend to improvements in existing processes, manufactures, machines, and so on; experience having pointed out that, whilst absolutely "new manufactures" or processes are of rare occurrence, improvements of vast importance in or upon existing manufactures, processes, or machines are very numerous, and as late as 1852, the Amendment Act under which we are now working came into force. That Act contains provisions for the examination of the documents accompanying each application for letters patent; yet the examination is of such a nature, and based on a mere outline of the invention, as not to afford any certainty whatever that the letters patent granted are valid—being, in fact, a "look through," by one of the law officers of the Crown, of the provisional specification accompanying the petition; a document which usually in a meagre way sets forth the nature and objects of the invention, without minutely detailing how it is put into practice, and according to the information contained in which the law officer may either grant or refuse, or require the applicant to amend it; whilst, as regards the all-important document, the specification itself, the inventor is left to his discretion, for with it the Crown does not interfere until tested in the law courts: and it is perhaps hardly necessary to add that this freedom, in the hands of an unscrupulous patentee, is often most unfairly taken advantage of, by enabling him, on the one hand, to file such a specification that conveys no exact notion of the particular invention, or, on the other hand, to make claims for that to which he is not entitled; indeed, leaving it to the patentee's discretion whether to define his invention by claims or not; thus, indeed, aiding the patentee to extort royalties which legally are not due, merely because in so many instances manufacturers and others who use the patent cannot afford the time and money to dispute the validity of a vested right. This liberty as to the claims of a patent specification is undoubtedly the cause of oppression and extortion to a most unjust extent, and to obviate it must be one of the provisions in an amended law.

I repeat, then, that the true spirit in which letters patent for inventions were originally devised, has never been acted up to. Doubtless, too, under the past and present state of administering the law, and in later times, the Patent Office, this true spirit could not be enforced at the time of making the application; but it remains yet to be shown that, by an efficient employment of the means at our disposal, whether the novelty of each alleged invention for which letters patent are applied cannot be so far determined, as to stamp it at once with so considerable an approach to validity or otherwise, that the ground on which the letters patent may be granted or refused shall afterwards bear so important a degree of reliability, that the public may feel an amount of confidence in that which is granted or refused as will place both it and the inventor on a much surer footing than now exists. If proof be wanted that this may be effected, I have but to refer to the American Patent Office, where on the average about 20,000 patents are applied for every year, and the Chief Commissioner Fisher has recently reported, that out of every three applications one is refused; such is the result, in that country, of the careful examination with reference to pre-existing documents and existing patents, that each specification undergoes before the letters patent are allowed.* There is no country in the world wherein the rights of inventors are so carefully guarded by the State as in America; and by the system prevalent there, patent litigation and its costs are reduced to a minimum. The fact is, that the examination which the invention undergoes before being allowed stamps it with so large a degree of certainty, that infringement is reduced to a minimum, and a man's right of property in his matured invention is duly recognised. If all this good result, then, is effected in a country where at least five times the number of applications are yearly made to what are made in the whole of Great Britain and Ireland, surely our eyes cannot be shut to the duty which lies before us of using our endeavours to promote some such course at home. The American system, too, is attended with far less expense than our own; it being a very wise provision in the Act of Congress, that the expenses of the Patent Office shall not exceed the receipts; indeed, it is but just that if inventors are to give their time, labour, and means in working for the national good, that the portion which they pay to the State in appropriating the invention to themselves for a limited period, should by the State be expended in rendering the property or right conferred for that period as secure as possible. In Great Britain, however, there is every year an enormous surplus from Patent Stamp duties, between forty and fifty thousand pounds sterling, directly contributed by inventive talent. This is paid into the treasury, in place of being used for the benefit of the inventor, as it ought to be; indeed, it is not too

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'liberty; for the first, she may grant *non obstante* contrary to the penal laws; for 'the second, if any man out of his own wit or industry finds out anything beneficial 'for the commonwealth, or brings in any new invention, which every subject of this 'kingdom may use, yet in regard of his pains and travel therein, her Majesty per-'haps is pleased to grant him a privilege to use the same, only by himself or his 'deputies, for a certain time: this is one kind of monopoly. Sometimes there is a 'glut of things, when they be in excessive quantity, as of corn; or sometimes there 'is a scarcity, or a small quantity; and accordingly her Majesty gives license of 'transportation or of importation: this is another kind of monopoly. These, and 'divers of this nature, have been in trial at common pleas upon actions of trespass, 'and if the Judges find the privilege good, and beneficial to the commonwealth, they 'will allow it; otherwise, disallow it. Since the last Parliament, her Majesty her-'self hath given commandment to her attorney-general, to bring divers of them into 'the Exchequer; and at least fifteen or sixteen have been repealed, some by her 'Majesty's own express commandment, upon complaint made unto her by petition, 'and some upon *quo warranto* in the Exchequer.'

"The Queen sent a message to the House, importing that the monopolies should be revoked; whereupon an address of thanks was voted; it was delivered to her Majesty by the Speaker, attended by about 180 members, on the 30th Nov. 1601. The following is an extract from her Majesty's answer:—'I never put my pen to 'any grant but upon pretence and semblance made unto me, that it was both good 'and beneficial to the subjects in general, though a private profit to some of my 'ancient servants, who had deserved well; but the contrary being found by expe-'rience, I am exceedingly beholden to such subjects as would move the same at 'first.'—'That my grants should be grievous to my people, and oppressions to be 'privileged under colour of our patents, our kingly dignity shall not suffer it; and 'when I heard of it, I could give no rest to my thoughts till I had reformed it.'"—*Appendix to Report of Select Committee*, A.D. 1829, p. 166.

* It is well to mention here, in order to make clear a point on which great confusion exists—namely, that the Letters Patent and Specification are two distinct documents: that the Letters Patent do not describe the invention, but the title merely under which it is set forth in the Specification. The Letters Patent bearing the Great Seal have always been used by the Crown in making a grant to an inventor; and before the year 1711, the inventor was merely required to declare his invention by a very vague inventory. These inventories have recently been collected together in a volume by Mr. Dircks.

The following note respecting the origin of enrolling Specifications of Patent Inventions is from the Report of the Select Committee of 1829, p. 170:—

"Near the end of the reign of Queen Anne it became the custom to insert a proviso into all patents, to oblige the patentee to execute a complete specification of the invention for which the patent was granted, and also to inroll the same in the Court of Chancery, within a specified time after the date of the patent. Before that time, the patentee was not called upon for any specification; Mr. Savery's patent of 1698 has no such clause. The inconveniences of giving the patentee a privilege, without defining the object to which it extended, are obvious; nor could the public have had any security for obtaining the invention at the expiration of the patent. The authority by which this clause was introduced does not appear. It was not a Parliamentary measure. When Parliament gave a reward to Sir Thomas Lombe, in 1732, for silk machinery, a model was deposited in the Tower of London, where it still remains."

* In the Report of Hon. S. S. Fisher, Commissioner of Patents, for the year ending September 30, 1869, the following figures appear:—Receipts, $686,388.62; expenses, $472,462.60; excess of receipts, $213,962.02; applications for patents, 19,360; caveats, 3,686; applications for extensions, 153; extensions granted, 125; patents issued, 13,672; patents issued, but withheld for the payment of final fees, 899. The number of patents issued during the year is 481 less than during the previous year.

much to say that if the present Commissioners of Patents were provided with a sufficient number of practical and scientific examiners, one with assistants being appointed to take charge of each class of invention, that with the magnificent library and collection of documents which the State possesses, placed in a suitable building where all would be accessible for use, patent property would be as safe here as it is in America, infringement would be reduced to a minimum, and interfering patents would not exist. The great thing to be ascertained by such examiners is the *novelty*; it would be absurd to expect them to determine whether the patent should be allowed or not on the ground of its value or insignificance. That can never be known until it is put to the test of practice; but one thing is clear, that several very foolish patents which are yearly applied for—absurdities, such as machines for producing perpetual motion, flying in the air, &c.—would by such a system be peremptorily refused.

I take it for granted that every member of this Society is fully conversant with the attack against patents which was recently made in the House of Commons, and although the motion introduced fell flat and fruitless to the ground, still we are threatened with a similar one on the earliest favourable opportunity. It behoves us then as a Society which enumerates on its roll several distinguished inventors, patentees, scientific men, and manufacturers; it behoves, I say, the foremost Society in this, among the foremost of great cities—which has profited in past times so much, which at present lives so largely on the results of invention—to consider how far it will permit the recent and threatened coming outcry, without allowing its voice to be heard; without taking its own leading position in putting down a most illicit, unpatriotic, ruinous, and shortsighted attack upon, not the present laws themselves (for with that I should not venture to speak so strongly), but upon their policy, essence, or principle, which, by all earnest well-wishers of our land, by every one who has truly studied their influence and bearing, by every political economist worthy of our confidence, have been shown to extend a value and prestige to this little land entirely inestimable.

The remarks, Sir,* which fell from you in your recent inaugural address, wherein you stated the necessity of protection to inventive talent, gave a pretty clear expression of the views which we know to be held generally by those who have given themselves to deal fairly with the subject; neither did the President of our kindred Institution—the Institution of Engineers in Scotland—omit to state, in very decided terms, expressions of a like nature, and certainly what has fallen from both may be taken as the index of fact, and decidedly exponential of the reception with which any proposals for patent abolition will be met on "this side the Tweed."

The public of Glasgow, as second to no other which has pre-eminently derived advantage from the protection of inventive talent, must not, if it desires to maintain its present position as a leader in manufactures, in practical science, and commerce, be silent on an occasion when one of her strongholds is threatened with the "battering ram" of "abolition."

Let us, then, examine into the abolitionist's stronghold, upon which he seeks to destroy the rights of inventors. He starts upon the assertion "that they are monopolies; that, as such, they are odious and hurtful, are noxious weeds in the fair field of industry, are clogs on the smooth wheels of commerce." The abolitionist body, which does not, I believe, number many really significant names, contains some gentlemen who have profited largely in business, partly from having adopted some most important patented apparatus, but who, in some of their connections with patents, not having been quite so fortunate as they might have desired, proceed at once, from their own special case, to condemn the entire policy of a Patent Law. I could name one or two gentlemen, at least, belonging to the abolitionists—one or two of the most inveterate, in fact—who are well known to have risen to eminence solely by their patent monopolies, and yet these are the men who now propose to tear away the ladder by which they have ascended, so as to effectually prevent others, however deserving, from reaching the same goal.

The abolitionist party does not deal in facts at all that are of the least weight from a national point of view; and we must remember that it is far more of a national than an individual matter which we are met to discuss, and let us not forget to sink individual considerations, as of second importance to those which affect us as a nation—let us remember that individual interests *must* sink in deference to those which are national; therefore I hope we may have the credit in this discussion of doing what has not yet been done, namely, to get a clear comprehension of how far the present laws affect us nationally, and not look at them from the single point of view from which the abolitionists start their opposition. They take it up as a manufacturer's question solely; they deal only with theory unsupported by facts, whilst they have not looked at the matter at all from an opposite point of view. They suppress all evidence favourable to views opposed to that of abolition. In short, the abolitionists are fighting for the manufacturer, and against the public—the nation—and therefore their denunciations are groundless, idle, the mere assertions of unsound fancies. The abolitionist community, I repeat, appears not to possess the faculty of dealing with facts, with realities, but must needs raise a hue-and-cry about what it supposes may some day happen; and I think I may truly say, without offence to any one, that we challenge those gentlemen composing it to point out a single fact brought forward in any part of the evidence before the Royal Commission that in the least degree bears against the policy of patents, or exhibits their alleged injury to trade and commerce; and we may further challenge the abolitionists to show, on trustworthy grounds, one single point in all that has been written or said, but which is direct proof of the national as well as individual importance of a judiciously administered Patent Law.

Let us now consider—not merely for their importance, but really to see clearly their utter want of bearing, and thorough inconsistency, and, therefore, their insignificance—some of the grounds upon which the abolition of patents for inventions is urged. On the ground of what the abolitionists call "natural rights" of property in invention, it is declared an inventor has but two "natural rights," the right to use his invention and the right to conceal it; and that, while the State is bound to protect the inventor in the free exercise of his right of use, it should, on the other hand, "*maintain the natural right of all its citizens to do whatever they please, provided it wrongs nobody.*" I humbly ask for evidence showing that the use of another's invention—which we well know in every case has cost the inventor much time and labour to bring into a practical condition, and in most cases has also cost him, in addition to his time and labour, a serious sum of money—I ask the abolitionist to show how its free use by the public would wrong nobody? Would not the inventor be wronged? Would he not be positively and most cruelly cheated? Has the abolitionist made himself aware of any of the numerous cases of inventors who were thus robbed of the fruit of whole years of labour, when, under the old law, the obtainment of patents was so costly that none but capitalists could embark in them? Does the abolitionist call to mind the numerous cases of men who have benefited the world so largely by their inventions, but who, for want of proper protection being secured to them, were frequently reduced to starvation and even death, and yet pretend to say that these men were rightly dealt with? Inventors may, indeed, be thankful that in later times, under the amended patent laws, their rights are more efficiently recognised than they were in the past darker ages. To talk of patents being wrong because they confer a monopoly, and are opposed to "natural rights," is simply to talk nonsense, is an attempt to deceive ourselves, and to do vast injustice by attempting to deceive our fellow-men.

Indeed, if we are to deal at all with this side of the question, I should say, and know well the majority will say with me, that every invention is "by nature" a monopoly, whether we have a Patent Law or not; because, in the very nature of mental planning and origination, every invention is the inventor's own possession *solely*, as long as he chooses to confine the knowledge of it to himself for his own behoof and benefit, or to any number of others for their joint behoof and benefit. Yet experience on all hands proves that inventive monopoly of this nature, that is to say, *secretly* employed, is productive of the *least* advantage to the inventor, and is not unfrequently injurious to the public, and I should like the abolitionist to point out, if he can, that by the patent system both inventor and public are not immensely benefited, for he must show *that* amongst numerous other disadvantages if he expects an inventive British nation to assent to his dictum of total abolition.

The framers of the law most wisely devised it so that the *maximum* advantage should be secured to the nation, by allowing the inventor the stimulus of its exclusive use and exercise for a certain number of years, in order that at the end of that time it might be secured to the public, in return for the benefit conferred upon the inventor over a limited period; by requiring him to file a complete specification of his invention, and the manner of putting it into practice, of whatever nature it might be. Indeed, while recognising every man's right to the *materially embodied results* (not the mere ideas on paper, bear in mind) of mental origination, experiment, expenditure of time and money, the State's chief object, under the Patent system, has been to secure the invention to the nation; and I suppose it is hardly necessary for me to ask you to look around this great city—with its weaving and spinning mills, its iron-works, forges and rolling mills, its shipyards and engine-works, its alkali-works, its oil-works, its sugar refineries, its calico-printing and Turkey-red dye-works, its potteries and glass-works, its paper mills and its corn mills; it is barely necessary to ask you to look at the ships in our harbour or the locomotives on our railways—and to enquire if all this teeming industry, all this wondrous productive ability, forcibly tells us whether we have profited or not by securing to the nation the thought, the foresight, the skilled plans, the cunningly wrought devices of such men as Lewis Paul, Thomas Highes, and Richard Arkwright, of Hargreaves, of Kay, or Heilmann, or Lister, of Dudley, Cort, Beaumont Neilson, Siemens, or Bessemer, of Joseph Whitworth, Richard Roberts, or James Watt, of Robert Napier, Penn, or the Maudslays, Rennies, Stephensons, and Fairbairns, or James Young; and does the work, the offspring of their labours, prove to us that we should have been better off, and as far on in the race towards the acme of economy and productive capability, but for the stimulus and value imparted to inventive talent by a Patent Law?

Were it possible to ask those whom I have mentioned their judgment as to the abolition proposal, we know full well the answer we should get; but I am sure you will agree that it is idle to say more on what the abolitionist calls the "natural" side of the question, so, therefore, we will proceed to another head which must pass under review, namely, what is alleged to be the wrong done to rival inventors.

The abolitionist (in substance) further says, it is essentially wrong to grant a patent to the man who first brings an invention to maturity, because it is quite possible that any other man or number of men may, in the course of experiment, eventually discover the same thing. The Arch-supporter from this point of view is the Rev. Professor Thorold Rogers, of Oxford. Perhaps I should say that this reverend gentleman has appeared before the British Association and elsewhere on the subject we are dealing with, and I think I may be allowed to say, *but with delicacy*, that the members of the Philosophical Society will scarcely allow that a clergyman, resident at a University, is the man in the right position to deal with the facts, conditions, and results of invention, which are more intimately bound up with our like—the inhabitants of great manufacturing communities. I apprehend you will agree with me that extremely little of importance hearing practically upon the present hue-and-cry against protecting inventive talent is to be learned from the dictum of the occupant of a professorial chair at Oxford. For note what is said:—"In ninety-nine cases out of a hundred, the patentee is only a simultaneous inventor with a number of others, who lose their labour and ingenuity because one man happens to get in first."* This extract is perhaps all that is necessary to show the ill-considered conclusions of the abolitionist party.

Where are the proofs that in *ninety-nine cases out of every hundred* the patentee is only a simultaneous inventor with others? At this place it is sufficient to contradict the assertion, as being wholly untrue; so palpably false, indeed, that no argument is needed to support the contradiction. That it sometimes happens

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* Addressing the President.

* On this point see Professor Rankine's remarks.

that a similar result is elaborated by more than one individual is perfectly true, and sometimes simultaneously; this is only the natural consequence of a public's demand for something which it does not already possess as readily as it desires, or that that which already exists does not suit the public taste, or that something totally new is asked for; but in this, as in every other mode of meeting a public want, why is not the man of greatest enterprise, he who is foremost in the race, to reap the greatest benefit, which, as in every other transaction or pursuit, is what all who work at it labour after? Where there is a prize to be won, surely it is due to him who first fulfils the conditions on which it is to be possessed, quite independently of any question as to the number of competitors.

If the abolitionist desires to know the frequently experienced truth, I will here give it him in the words of Judge Grier:—"It is usually the case when any valuable discovery is made, or any new machine of great utility has been invented, that the attention of the public has been turned to that subject previously, and that many persons have been making researches and experiments. Philosophers and mechanicians may have in some measure anticipated in their speculations the possibility or probability of such discovery or invention; many experiments may have been unsuccessfully tried, coming very near, yet falling short of the desired result. They have produced nothing beneficial. The invention, when perfected, may truly be said to be the culminating point of many experiments, not only by the inventor, but by many others. He may have profited indirectly by the unsuccessful experiments and failures of others, but it gives them no right to claim a share of the honour or profit of the successful inventor. It is when speculation has been reduced to practice, when experiment has resulted in discovery, and when that discovery has been perfected by patient and continued experiments, when some new compound, art, manufacture, or machine has been thus produced which is useful to the public, that the party making it becomes a public benefactor, and entitled to a patent. And yet, when genius and patient perseverance have at length succeeded, spite of sneers and scoffs, perfecting some valuable discovery or invention, envy robs him the honour, while speculators, swindlers, and pirates rob him of the profits. Every unsuccessful experimenter who did or did not come very near making a discovery, now claims it. Every one who can invent an improvement, or vary its form, claims a right to pirate the original discovery. We need not summon Morse, or Blanchard, or Woodworth, to prove that this is the usual history of every great discovery or invention."

I do not mean to argue but that licences should be compulsory—I certainly think they should be; and if that were enacted, it would have the effect of reducing royalties to a fair value—because any one applying for a licence, in the event of a refusal, would then have an appeal to some court of law, where the grounds of refusal would have to be stated, and the judge would, upon the facts produced, legislate as to the royalty the patentee would be entitled to demand.

If property in the results of matured thought, of experiment after the expenditure of time and means, is essentially wrong and inflictive of injury upon others, why, then, it is equally wrong to possess property of any kind, because, if the possessor is better off than his neighbours in one case, he must also be in the other. The abolitionist, in order to be consistent, must equally urge that yonder owner of landed property, or house property, of capital realised out of speculation, or a careful watching of commercial trading and enterprise, must at once give it all up, after his years of labour, for the benefit of this or that man, simply because, in the nature of things, had the others been similarly placed, each might have achieved the same results; the abolitionist would not debit the shrewdness, the tact, the forethought, and constant watching of time, circumstances, and events by which the results have been effected, with any share in the profits.

"The public, the millions, have a greater interest at stake in the maintenance of a Patent Law than they are aware of, because its importance has not hitherto been brought under public notice. To abolish Patent Law means to depress and almost to stifle competition in all trades and manufactures; and just as manufacturers have over and over again combined to enter upon expensive legal processes to thwart the right an inventor has obtained from the Crown through the medium of letters patent, so also might they at any time combine to maintain high prices for articles of universal consumption;"* so that positively patent protection is a check against combination of the manufacturers, is a power in the hands of the public to keep down the prices of articles to a reasonable uniform standard.

Argue as we will, start from whatever point of view we may, one thing is evident, that in order to secure inventive talent for promoting the national good, we must hold out reward to the inventor; the abolitionist even owns that the inventor should not go unrewarded. Invention, we have abundant proof in those countries where there is no Patent Law, is not productive of national advantage, and precisely from the lack of stimulus which the Patent Law affords: for example, when do we hear of an important invention coming to maturity in Switzerland, where there is no protection for inventors? yet this is not because there is no inventive talent in the Swiss, but purely and simply for the reason that there they cannot employ it to advantage, and have to come here or go elsewhere, where inventive talent is legally recognised, in order to secure that reward which the public appreciation of the invention indicates as the due value. It being on all hands, then, admitted that the inventor must be rewarded, we have next to consider what means are available for securing that to him, and, of those means, which is the best for both the parties concerned, the nation and the inventor.

As to available means of reward, there are only two of which I am aware that can in any way be dealt with, namely, State rewards, or that which is secured by a Patent Law. Of the former we have some knowledge; it has been tried, found wanting, and is now an exploded delusion. At one period it was the case that the State rewarded inventors by payment of a sum of money, sometimes with and sometimes without the addition of a Patent, and the chief effect of it was to directly encourage fraudulent and misdirected ingenuity, as proven by the Appendix to the Report of a Select Committee of the House of Commons, who examined the Patent Laws in 1829.*

We are brought, then, to conclude that the patent system is the only one by which the nation can secure the maximum advantage from invention, the only one by which invention is properly encouraged, the only one by which the real value of an invention can be ascertained, and, therefore, the only one which can secure not merely a reward, but a due reward, precisely its exact worth, to the inventor.

Whilst, then, no fault is inherent in the theory of the present law, whilst theoretically, indeed, it is precisely the right thing, and when, under certain grievous defects in present practice, the country has so unprecedentedly advanced, and individuals have so largely benefited, it must be abundantly apparent that, if that law is only put on a more equitable basis for its administration, by which the existing anomalies and errors would be wiped out, then the real result can only be a still greater progress in those advantages. To say that the time has arrived when, in the interests of trade and commerce, it is proper to tear down the link which has enchained invention to the British nation, is simply intolerable; it is, as Whately wrote, like "those who, having magnified into serious evils by injudicious opposition heresies in themselves insignificant, yet appeal to the magnitude of those evils to prove that their opposition was called for; act like unskilful physicians, who, when by violent remedies they have aggravated a trifling disease into a dangerous one, urge the violence of the symptoms which they themselves have produced in justification of their practice."

We have had experience in former times of patents at a great cost, and, more recently, of patents at a reasonable cost, and that experience shows that under the old system of costly patents a great part of the real value of invention was lost to the country; the great expense to obtain the needful property in an invention, in order to render it of public benefit, became often a barrier to realising the property. Not unfrequently it was productive of crime, through stimulating the abomination of *secret* working.

All this has in a great measure been set aside by the comparatively cheap patents granted since 1852. The abolitionist, however, would not even amend the present law, but positively proposes to eradicate protection to inventive talent altogether. Yet I should like to ask one of those gentlemen (Mr. Macfie) how he would have felt in 1850 if some one had come forward to press a total abolition in that year, when he himself applied for a patent to improve his own manufacture. His views have undergone a change since then, and we should like to know his

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* "Letter to Lord Stanley," by H. Dircks part 2.

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* List of State Rewards made to Inventors from 1713 to 1788; from the Report of the Select Committee of the House of Commons in 1829:—

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| For discovering methods of finding the longitude at sea | |
| Harrison | £20,000 |
| Others | 15,860 |
| For introducing three Italian machines for the manufacture of silk | |
| To Thomas Lombe | 14,000 |
| For a medicine for removing the cause of the stone | |
| To Johanna Stephens | 5,000 |

The following were made in addition to those grants for which special Acts of Parliament were passed:—

| | |
|---|---|
| To Dr. Irvine, for his method of making sea-water fresh and wholesome | 5,000 |
| To David Hartley, to enable him to ascertain the practicability and utility of his method of securing ships and buildings from fire | 2,500 |
| To various persons for discovering useful dyes for manufactures | 5 500 |
| To Charles Dingley, for erecting a public windmill for sawing timber | 2,000 |
| To John Blake, to assist him in carrying out his scheme of transporting fish to London by land carriage | 2,500 |
| | £72,360 |

List of State Rewards made to Inventors subsequent to 1788:—

| | |
|---|---|
| Parliament granted to Mr. Elkinston for discovering his mode of draining land | £1,000 |
| To Mr. John Davis, for his discovery of the method of cleaning smutty wheat, granted 1800 | 1,000 |
| To Thomas Foden, Esq., towards enabling him to prosecute a discovery made by him, of a paste as a substitute for wheat flour, in 1801 | 500 |
| To Dr. Jenner, for promulgating his discoveries of the vaccine inoculation, in 1802, a reward of | 10,000 |
| 1807, a further reward of | 20,000 |
| To Dr. Edmund Cartwright, for various mechanical inventions, granted in 1809 | 10,000 |
| To Captain Manby, as a reward for his invention of effecting a communication with ships stranded, and for expenses in carrying into execution his plan for saving the lives of shipwrecked mariners, granted in 1810 and 1812 | 3,250 |
| To Mr. Greathead, boat-builder, for his invention of a lifeboat, affording greater security to the lives of seamen and others, in cases of shipwreck | 1,850 |
| To Mr. Crompton, for inventing the machine for spinning cotton, called the mule | 5,000 |
| To Dr. Smyth, for his discovery of nitric fumigation, to prevent the communication of contagion, in 1813 | 5 258 |
| Miscellaneous rewards at various times | 1,305 |
| | £59,163 |

reasons, if valid, reasons—based on fact, and not on hypothesis—he has to give us, reasons which we can accept as fit for the Government to legislate upon.

That gentleman's evidence before the Royal Commission in 1863-4 is of the most extraordinary, fanciful nature; there is not a fact in it which tells against patents; and the concluding questions put by Lord Overstone, who evidently had seen through the hypothetical mind of the witness, will show you at once how far it is worth looking into. When his Lordship asked, "Is not one of the strange things which happen in practice this—that in practice none of the apprehended grievances which you have expatiated upon have occurred?" Answer, "But they must occur the first hour in which we have an important sugar-refining patent." Or to take another question—"During the last ten years, the practical grievances which you apprehend as in prospect have not occurred?" Answer, "They have not occurred."

If the gentlemen who so urgently pursue the cry of abolition would help us to amend the discrepancies in the present law, we should then have no fault to find with them. As a nation which lives so largely upon the returns secured to us by the protection granted to the embodied results of inventive genius; a nation which not only lives, but influences the whole world, thereby in so many ways; which scatters the direct products of its inventive talent to feed and clothe, to teach, and emancipate from the thraldom of ignorance the sons of toil in every clime; a nation which, by the very essence of invention, influences so effectively the march of civilisation, and, in return, brings home to her own door such gains—I say, then we could tolerate these gentlemen, who, no doubt, as they are now working, believe themselves to be our best friends, for the assistance which, in such a position, they would be able to afford us.

And in order to appreciate the importance of nursing invention, we need not go beyond our own precincts. I should like the abolitionists to tell us where our iron manufacture would have been but for Beaumont Neilson's Hot-blast Patent? or where the steam-engine itself would have been but for James Watt's patent? Where our weaving or spinning mills would have been but for the stimulus held out by patents to the endless numbers of inventors who have worked therein, and the intrinsic worth of which, in a national sense, it is beyond our power to estimate? And what shall I say of steam navigation, which was given birth to at our very doors; or of the vast improvements in shipbuilding, which have tended so to make the Clyde the great shipbuilding yard which she is? Need I further allude to our sugar refineries, with the number of important patented inventions at work there; or shall we look to the potteries and glass works, and the innumerable chemical works, and will it be said, in face of all this, that the protection afforded to inventive talent is virtually wrong, is intrinsically pernicious, and productive of widespread injury to the whole face of mankind? Let us take the reverse view, and for a moment suppose that we had had no protection, what would have been the result? viz. this—that, whereas there would then have been no such stimulus to inventive talent, we should have had no alternative but to make the most we could out of existing ways and means, as it would not profit us to make a step in advance if, to effect that, we must first expend often an enormous capital to prove and perfect our invention, and no sooner to have it perfected than to see, as the only result, our neighbours on all hands take advantage of our labour, time, and money, without let or hindrance; whilst the inventor himself would have to work with it as best he could with crippled means, not to profit, bear in mind—but, first of all, to repay himself that which he had expended for the benefit of his fellow-men—but loss to himself.

Does any one suppose that invention would be recognised, or could flourish in a country where such a state of matters existed, and it is to such a condition that the abolitionists would reduce us; or that any one would commit himself to such an act of loss as the elaborating and perfecting of an important invention involves, merely to get as his reward the temporal honour of being called "the inventor"?

I would, if time permitted, bring forward many more such arguments not less powerful; but I am sure that the citizens of Glasgow have too much good sense not to comprehend the rectitude and absolute necessity for a judiciously administered law for protecting the inventive talent of this country.

So far as our requirements, comforts, and independence are concerned, I cannot, for my own part, see to what other faculty of the human mind we primarily owe so much as to invention; for go where we will, try our hand at whatever we may, we cannot get out of its influence. Through securing and cherishing invention is it that our bodies are clothed and housed; our roads reclaimed from the mud-track; our railways, steamships, and telegraphs carrying us and intelligence of all kinds at such speed as to make the most of time. The success, too, of the trader, to a large extent primarily depends upon the direct products of that faculty; the national revenue is vastly affected by it. When, then, this one mental faculty has primarily been the means of elevating our land and people to so lofty an eminence —when individuals cannot avoid depending on it—surely we should pause ere we commit ourselves to the wholesale abolition which the leaders of this new thing—this anti-patent proposition—so vehemently contend for.

In conclusion, gentlemen, after a very incomplete allusion to some of the vital points only which demand our attention, with having made no allusion to the copyright analogy, and which, I trust, will now be fully developed in discussion —to commence which has been the purpose of this paper—I will only repeat some rather forcible words which have recently been used in a certain high quarter, and appear to meet our present case with exceeding fitness, namely, not to forget that, whether we are Radicals or Conservatives, we require to be reminded that truth or falsehood, justice and injustice, are no creatures of our own belief. We cannot make true things false, or false things true, by choosing to think them so. We cannot vote right into wrong or wrong into right. The eternal truths and rights of things exist, fortunately, independent of our thoughts or wishes, fixed as mathematics, inherent in the nature of man and the world. They are no more to be trifled with than gravitation. If we discover and obey them, it is well with us; but that is all we can do." *

* J. Anthony Froude's Rectorial Address at St. Andrew's University, 1869.

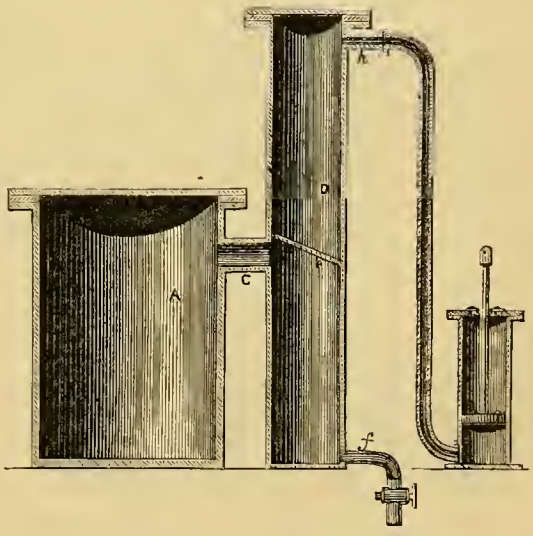
## RECENT PATENTS.

### PRESERVATION OF MEAT.

John Henry Johnson, 47 *Lincoln's Inn Fields; a Communication from* Azel Storrs Lyman, *New York, U.S.A.—Patent dated July 7*, 1869.

This invention relates, first, to an improved mode of preparing meat for preservation by removing the animal heat, the deleterious gases, and a portion of the water therefrom; and, secondly, to an improved mode of preparing and preserving roast meat in a condensed or concentrated form. The object of this invention is to remove the decomposing products (which are composed principally of ammonia, and other compounds of hydrogen) as quickly as possible; and to this end the inventor places the meat in a vacuum so perfect that water will boil at a temperature below blood-heat, when the deleterious products, boiling at a lower temperature than water, are distilled from the fluids of the meat. But ammonia has a strong chemical affinity for water, and a large per-centum of water is evaporated with it, and consequently, before the ammonia and other matters are all evaporated from the centre of the meat, the water near the surface has evaporated until the meat is cooled from about blood-heat down to 36° or 40° Fahrenheit by this evaporation, and has lost from four to six per-centum of its weight.

Fig. 1.




It would be impracticable, if not utterly impossible, the inventor states, to remove these vapours by the vacuum-pump alone, for two reasons: first, on account of their enormously increased volume at that low pressure; second, because, when the piston comes down upon them, they condense in the cylinder of the pump, instead of being forced out against the pressure of the atmosphere, and when the piston rises again, they flash into vapour and fill the pump, so that the pump ceases to withdraw either air or vapour from the vacuum-chamber.

These difficulties are completely remedied by the introduction of a suitable condenser or absorbent between the meat or vacuum-chamber and the pump. For this condenser a reservoir of fragments of ice may sometimes be used. On these fragments the ammonia, and some other impurities, together with the vapour of water, are condensed, while the air only passes on into the pump. This pump, which may be of any ordinary or suitable construction, should be so perfect as that, when drawing off the air through ice, the meat will be cooled from blood-heat down to 36° or 40° by its own evaporation, within from five to ten minutes. It will be found to have shrunk in weight from four to six per-centum during this time.

Fig. 1 of the accompanying engravings represents a sectional elevation of an apparatus of the kind above referred to.

The pipe C connects the meat or vacuum-chamber A with the condenser D, in which the ice is held on a grating *e*. A pipe *f*, at the bottom, serves to draw off the matters which gather there, and a tube *h*, at the top, connects the condenser with the pump. In place of ice in the condenser, other condensing or absorbent substances, such as sulphuric acid, may be used. This can be effectively used by saturating pumice-stone with the acid, and then pumping through it, and in various other ways.

Fig. 2.

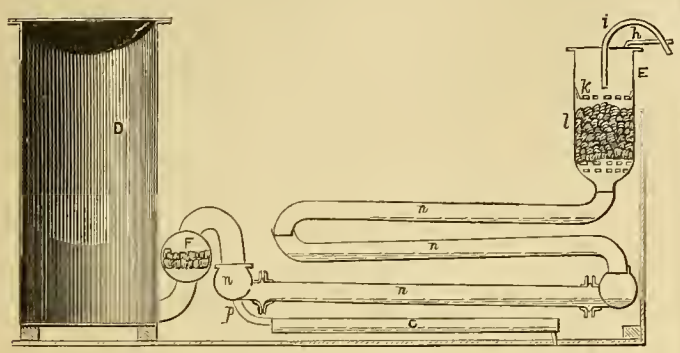



Fig. 2 shows an apparatus which can be advantageously used in this manner. The vacuum-chamber is represented at D, while the pipe leading to the exhaust-pump is shown at *h*.

This pipe opens into a receptacle E, which is also entered by another pipe *i*, leading from the sulphuric acid reservoir.

The acid, passing from the pipe in a determinate quantity, drops through a diaphragm *k*, and percolates through a mass of pumice-stone or coke *l*, which rests upon a grating in the receptacle E.

The lower end of the receptacle communicates with a coil of tubing *n*, each bend or fold of which dips or slants somewhat, so as to retain a sufficient quantity of the acid, which flows slowly through the coil.

Fig. 3.

The bottom portion of the coil consists, in this instance, of three pipes, seen in plan, fig. 3, which have the bent or curved form there shown, in order to admit of the contraction and expansion consequent upon the heating and cooling of the apparatus taking place laterally, and without deranging or damaging the parts of the apparatus.

The lower part of the coil communicates with a filter F, filled with caustic lime, or its equivalent, for the purpose of taking up the offensive gaseous and other matters drawn from the meat in the vacuum-chamber D, with which the filter is connected in the manner represented.

The box *n'*, which unites the ends of the three tubes *n*, forming the lower portion of the coil, is provided with a pipe *p*, which leads into a reservoir G, and conducts there the dilute acid passing from the coil. The acid is thence drawn off from time to time, and concentrated, so that it can be again used.

These apparatuses are given as examples only of some of the modes of carrying out the invention, but it is obvious that many other forms of apparatus can be devised to effect the same result, viz. the condensation or absorption of the vapour before it reaches the vacuum-pump.

The mode of operation is obvious.

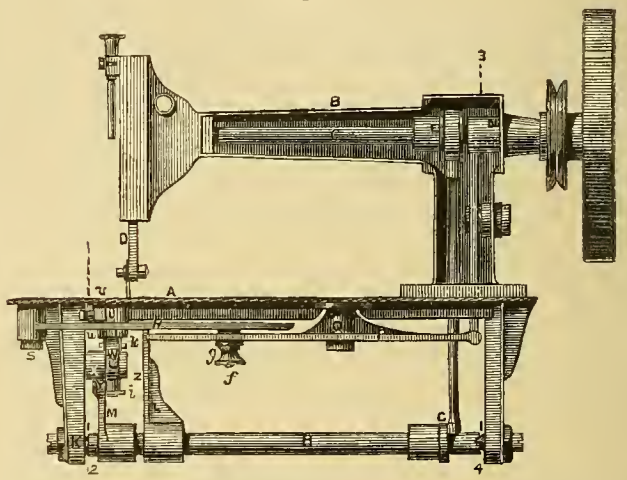
## IMPROVEMENTS IN SEWING MACHINES.

John Henry Johnson, *London and Glasgow. Communicated by* Leonard Erni, *of Zurich, Switzerland.—Patent dated July 19, 1869.*

This invention has reference more particularly to the feed-motion of sewing machines, and consists—firstly, of a peculiar combination of mechanism for actuating the feed-bar of what is known as the under "four-motion feed;" secondly, of a peculiar arrangement for regulating the horizontal throw of the feeding surface, whereby a greater range in the length of stitch capable of being produced in the same machine is obtained; thirdly, of an arrangement for varying or adjusting the height of the feeding surface above the cloth plate, or, in other words, of varying the extent of its vertical throw.

Fig. 1 of the engravings represents a side elevation of one type of sewing machine, with the improvements applied; fig. 2 is a plan of the under side of the table or bed-plate, showing the mechanism carried thereby; fig. 3 is a transverse vertical section of the front end of the machine, taken along the line 1–2 in fig. 1; and fig. 4 is a similar view of the driving end of the machine, taken along the line 3–4 in fig. 1.

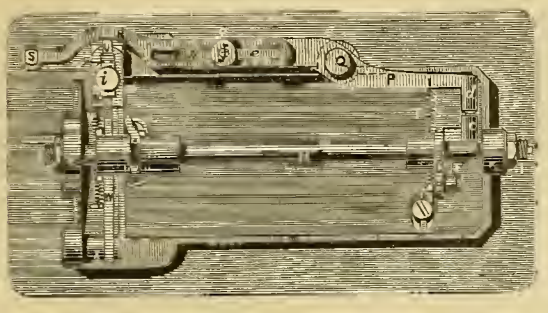
Fig. 1.




A is the bed-plate of a sewing machine, constructed on what is known in the trade as the "Singer" type; B is the hollow overhanging arm or bracket, within which rotates in suitable bearings the driving-shaft C, which transmits motion in the well-known manner to the needle bar D. Towards the rear end of the driving-shaft there is fitted on to, or formed in one piece therewith, an eccentric E, which drives an eccentric rod F, the lower end of such rod being jointed to a shank arm G, fixed on the rocking-shaft H. This rocking-shaft works between conical stud centres I I, screwed into the lugs K K, and if desired may carry a vertical oscillating shuttle carrier or driver L. Near to the front end of the rocking shaft H there is fitted a segmental rocking-cam M, the surface or periphery of which has a projection or incline formed thereon, as shown in fig. 3. The object of this cam will be fully explained below. By the side of the eccentric E, on the driving-shaft C, there is also screwed a cam or wiper N, which on rotating strikes against an antifriction bowl *a*, carried in the upper end of a vertical, or nearly vertical, lever O. This lever oscillates on the stud centre *b*, and its lower end is bent in the form of an elbow *c*, as shown clearly in fig. 4. The extremity of this elbow *c* works in contact with the rounded end of a corresponding elbow-bend *d*, on the ring end of a horizontal lever P, centred on a stud Q projecting from the under-side of the bed-plate or table. The opposite end of this lever has a long slot *e* made therein, through which passes a screwed pin *f*, provided with a tightening nut *g*. This pin enters also a slot *h*, made longitudinally in a second horizontal lever R, which is parallel to the lever P, but situate above it, and works at its front end on a fixed stud S projecting from the under-side of the bed-plate. By slackening the nut *g*, the screw-pin which connects the two hori-

zontal levers is free to be adjusted along the slots *e* and *h* respectively, and again fixed by tightening the nut, in order to vary the range of motion transmitted by the lever P to the lever R; the range of motion of the former being practically always the same, as it is dependent solely upon the throw of the wiper N and the length of the vertical lever O, and the position of the fulcrum *b* of that lever. T is a helical spring, which serves to bring back the lever P after it has been acted upon by the end of the vertical lever O. The lever R bears constantly against the front end of the horizontal feed-bar

Fig. 2.



U, and serves to impart thereto the forward motion requisite for propelling the cloth or other material being stitched, a roughened or serrated plate *h'* (fig. 3) attached to the feed-bar being caused to act directly upon the cloth, through an aperture in the cloth plate, as is well understood in this class of machinery. The feed-bar works between two guide-lugs *u*, at or near its front end, and is maintained therein (but allowed perfect freedom of horizontal motion) by a pin *v* passing transversely through a slotted opening in the feed-bar, and through the guiding-lugs. V is a helical spring, which serves to return the feed-bar to its original position again after each impulse imparted to it by the horizontal lever R, thus completing the to-and-fro horizontal motion of the said feed-bar. The vertical or up-and-down motion is imparted to the feed-bar by a lever W, working on a fixed centre X, and carrying an antifriction bowl Y, which rests upon the segmental rocking-cam M above

Fig. 3.

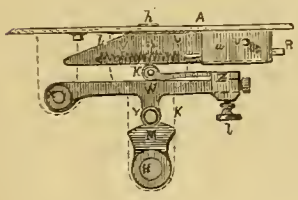
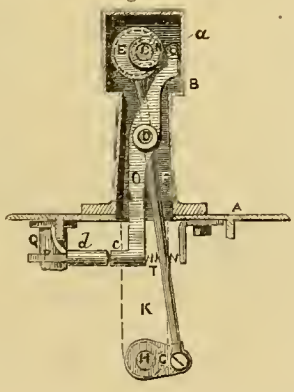


Fig. 4.



referred to. This lever W is provided with a sliding-piece Z, capable of adjustment along it towards or from its centre of oscillation, and of being fixed in any desired position by the pinching-screw *i*. An antifriction bowl *k* is carried by the adjustable sliding piece Z, and bears against the under-side of the feed-bar U, the latter being pressed downwards so as always to remain in contact with the antifriction bowl *k*, by a blade-spring *l* (fig. 3), fitted into a recess cut in the under-side of the table or bed-plate. By properly timing the motions of the wiper N and segmental cam M, it follows that the horizontal and vertical motions of the feed-bar U will occur in their proper order, and by adjusting the pin *f* along the slotted levers P and R, the forward motion of the feed-bar will be increased or diminished, and the length of the strokes varied accordingly, whilst at the same time, by adjusting the slide Z along the lever W, the vertical throw of the feed-bar will also be varied so as to accommodate it to the nature of the fabrics operated upon.

## OBTAINING EXTRACT FROM HOPS.

JOHN HENRY JOHNSON; *a Communication from* H. BURGESS, *of U.S.A. Patent dated July* 21, 1869.

THIS invention relates to the obtainment of the extract from hops, and consists in digesting the hops from which the extract is to be obtained in bisulphide of carbon, either alone or mixed with alcohol, ether, or chloroform, until the flavouring principle or essence of the hops is extracted. The bisulphide of carbon is then drawn off by the application of heat, the extract being left behind.

In order to effectually collect the extract, paper or other bibulous or absorbent substance may be placed in the retort or vessel, which will take up the matter in the same, but will only give off the bisulphide on the application of heat. The extract, remaining in the pores of the paper or other absorbent material, may be readily obtained by immersing the said material in water or wort.

## IRON AND STEEL.

JOHN HENRY JOHNSON; *a Communication from* J. J. JOHNSTONE, *of Pennsylvania, U.S.A.—Patent dated August* 11, 1869.

THIS invention has for its object the providing an easy, cheap, and desirable means for the purifying and refining of all kinds of pig metal, and at the same time to facilitate and reduce the cost of manufacturing it into a superior article of wrought-iron or steel.

The introduction and use of stone-coal, coke, and hot-blast, in the reduction of iron ore to the metallic state, has occasioned much bad pig-iron, known to the trade as "red-short," "cold-short," and "rotten-short," and this condition of the art being common and extensive, has produced a general desire among manufacturers of iron and steel for some sure, easy, and economical means for removing the impurities in the pig-metal prior to transferring it to the puddling or heating furnace, and at the same time to lessen the time, labour, and cost of manufacturing it into a good article of wrought-iron or steel.

To accomplish the removal of the impurities in the pig metal, manufacturers of wrought-iron and steel have had recourse to the bloomery fires, finery fires, and forge fires, in all their varieties. They have also resorted to the use of the "Catalan forge," "German forge," "Wolf's oven," "blue oven," "crucibles," and furnaces in all their varieties. They have also resorted to the puddling, boiling, and granulating processes, to the use of fluxes and "physic," consisting of metallic oxides, earths, alkaline, saline, and carbonaceous matter in different quantities, and variously combined and compounded. They have also had recourse to gases, acids, water, steam, and air, using them separately and combined, and applied in almost every conceivable manner; but all these agencies have failed to produce the desired result, viz. the purifying and refining of the various kinds of pig metal, and facilitating and lessening the cost of manufacturing it into a good article of wrought-iron or steel, to that degree desired by the manufacturer.

Now the nature of this invention consists in bringing melted metal direct from iron ore, or pig metal remelted into its most fluid condition, and then purifying and refining it by mixing with it a metallic oxide, and then forming it into plates or bars of wrought-iron, by pouring the molten metal thus purified and refined, and while still in a fluid condition, into moulds formed of a metallic oxide, or moulds coated with a metallic oxide.

In carrying out this invention the inventor takes a good article of iron ore, and crushes or pulverises it, so that it will pass through a "No. 8 sieve."

He then brings the metal direct from the iron ore, or pig-iron remelted into its most fluid condition, or, as the ironfounders say, "to a milk-white heat," which can be done by a suitable application of heat in a furnace or cupola.

The molten metal is then run into a shank, ladle, or other vessel, which has been coated with a pasty material formed by mixing very finely-pulverised iron ore and water together, and this coating on

the shank, ladle, or vessel, thoroughly dried before the molten iron is run into it, and then mixing into and among the molten metal, the pulverised iron ore, mixing from eight to twelve pounds of the pulverised ore with about one hundred pounds of the molten cast-iron, taking care to mix thoroughly together the molten iron and pulverised ore, so that the particles of each will come in contact with each other, which mixing may be performed by the use of a suitable tool, by preference made of a flat bar of iron. The lower end of the mixing-tool should be coated with a pasty material formed of the finely-pulverised iron ore and water, and the coating on the tool should be thoroughly dried before using it.

The pulverised ore may be mixed into and among the molten iron while in the furnace, by having the furnace suitably constructed for that purpose, and by the use of a suitable mixing-tool.

The pulverised iron ore should be heated to about 150° Fahrenheit prior to mixing it into and with the molten iron.

After the pulverised iron ore and molten iron have been mixed together, in the manner and by the means hereinbefore described, the mixed and fluid mass is poured into moulds formed of finely-pulverised iron ore, which has been so crushed and pulverised that it will pass through a "No. 16 sieve." The crushed and pulverised ore should be moistened, and tempered with water, in the manner practised by "ironmoulders" for tempering and preparing moulding sand.

After the pulverised ore has thus been prepared, he takes a suitable flask, and patterns of the form of the plates or bars desired. With this flask and pattern he forms moulds, in and by any of the known means practised by ironmoulders in the foundry; or takes metallic moulds, of suitable size and form for making the desired plates and bars, and coats the moulds with a pasty material consisting of finely-pulverised ore and water. The metallic moulds, after being coated, should be thoroughly dried before pouring into them the fluid metal, purified and refined, as hereinbefore described.

It is found, by experience, that one-half inch in thickness for the plates answers best for making a superior article of wrought-iron, and that one inch in diameter is a good size for the bars; but the plates may be made from one to three inches thick, and from five to ten inches wide, and from one to three feet long; and the bars may be made from one to three inches in diameter, and from one to three feet long; and, in every case, a most excellent article of pure and fibrous iron made therefrom.

After the hereinbefore-described purified, refined, and fluid metal has been poured into the moulds, and it has become sufficiently congealed, the plates or bars are then removed from the moulds, and, after being exposed to the action of the atmosphere until they become cold, they are then, in suitable quantities, placed in a puddling or heating furnace, and properly heated, and worked into balls or piles, which are then hammered, or squeezed and rolled, or otherwise worked and manipulated, in any known manner, for making it or them into any desired form of merchantable iron or steel.

The melted cast-iron may be treated with any suitable "physic," prior to mixing the pulverised iron ore into and with the fluid metal, and other metallic oxides, alkaline, saline, and carbonaceous matter, may, in limited quantities, be mixed and compounded with the pulverised iron ore, prior to mixing it with the fluid cast-iron, for purifying and refining it. The operator must always be careful to have the molten cast-iron in its most fluid condition prior to mixing the pulverised ore into and among it. Otherwise, the operation of purifying and refining it, and pouring it into the moulds, will be imperfectly done.

The operator should always take care to skim the fluid mass prior to or during the time it is being poured into the moulds.

The novelty of the improved process consists in bringing cast-iron into its most fluid condition, and then purifying and refining it, by mixing with it solid oxides, pulverised, and then pouring the purified and refined metal, while still in a melted condition, into moulds, prepared as hereinbefore described, and thereby producing an article of wrought-iron, by this process, which is superior in quality to that obtained in the ordinary way.

## FELTED FABRICS.

JOHN HENRY JOHNSON; *a Communication from* F. A. DUCHENE, *of Paris.—Patent dated August* 9, 1869.

THIS invention has for its object the uniting of silk with the hair of animals by a felting process hereinafter described, thereby obtaining a fabric perfectly uniform in all its parts, in which fabric the two materials form surfaces of a different nature, which surfaces the felting intimately unites; whilst the product possesses, in a higher degree than that manufactured by former methods, every property calculated to render it suitable for various useful purposes.

If it be required to manufacture a hat, for example, the silk is first reduced to the finest state of division possible, and the first layer is made with hair or wool, which is then covered with a second layer of silk; and this process is continued until the product is ready for fulling, which is effected by the use of soapy water, as in the manufacture of cloth. By these means a hat is obtained in one piece with the silk on the surface, without the necessity for a "body," whilst in the ordinary mode of manufacturing silk hats a body is indispensable, as also is the sewing required to unite the pieces of the fabric.

For the manufacture of fabrics the process is commenced by preparing, by means of the carding-engine, a lap of a single material, to which the required dimensions are imparted on an endless cloth beam; on this is placed another lap of silk alone, and the two together are then subjected to the action of the machine, which unites them sufficiently to enable the fabric to withstand fulling, the latter operation being performed by means of soapy water.

The thickness depends on that of the laps and the degree of fulling. It is thus possible to obtain products varying in thickness from a light fabric to a felt suitable for use in carding-engines.

It will be perceived that by this process acid or mercurial salts are entirely dispensed with, which obviates many inconveniences, and fabrics are obtained each surface of which is of its own nature suitable for a particular purpose. Thus, articles of wearing apparel made up from these fabrics afford the advantage of hair or wool on one side and silk on the other.

Felted goods have ordinarily no selvage, by which their strength and durability are impaired, whilst the fabrics manufactured by these processes are provided with selvages, which form part of the felted lap. These selvages are obtained by placing on the edges of the lap a number of parallel threads, which are united together by felting; that is to say, by the union of the hairs with the silk in the general operation. As the lap is unwound, it receives from one or more bobbins the requisite number of threads to form a selvage of the desired width. This selvage, formed of parallel threads, is then fulled with the rest. It should be observed that by the same process a felted fabric may be made, the whole width of which is composed of a threaded warp similar to the selvages hereinbefore described.

## LAW REPORT.

GLASS FURNACES.—CANNINGTON *v.* NUTTALL.—Court of Chancery, Lincoln's Inn, before Lord Justice Giffard, January 29th, 1870.

Mr. Grove, Q.C., Mr. Fooks, Q.C., Mr. Theodore Aston, and Mr. Carpmael were for the plaintiffs; Sir Roundell Palmer, Q.C., Mr. Jessel, Q.C., Mr. E. Macnaghten, and Mr. Herschell for the defendant.

This day the judgment of the Court was given upon this motion for a new trial. The case was tried before the Master of the Rolls and a jury in November last, when a verdict was found for the plaintiffs. The defendant moved for a new trial. The case was argued on the 19th and 20th January last. The plaintiffs, Messrs. Cannington, of the Vauxhall Works, Liverpool, have for some time past made use of glass furnaces constructed according to the specification of Pocheron's patent of 1866, of which they are the proprietors. Pocheron's process is a method of adapting the ordinary glass furnace to melting glass in bulk, by using a tank or chamber of firebrick, with a furnace at each end, and so dispensing with the pots in which the metal is ordinarily fused. As the pots, according to the evidence of one of the witnesses, last on an average some six or seven weeks only, while the tanks last as many months, this would seem to be a great improvement on the old process, besides the saving of expense which was occasioned by the constant cracking of the pots, which cost 7*l.* or 8*l.* each to make. In order to keep the sides of the tank

cool, and prevent the molten metal from oozing through the walls of the tank, M. Pocheron made the walls of his tank hollow, so that a current of cool air might circulate around the inner side of the tank, which thus stood, as a witness expressed it, in a basin of air. Some months before the filing of the bill the defendant erected at his works at St. Helen's a tank furnace, with a split bridge to admit heated air, which air was not carried, as in M. Pocheron's invention, round the tank, but was confined to the interval between the furnace at either end of the tank and the tank itself. The defendant's object in this was, he stated, to promote the fusion of the metal, and not, as in Pocheron's case, to protect the walls of the tank. The plaintiffs considered that their patent rights were being infringed by the use of this furnace, and instituted the present suit.

The defendant denied the novelty as well as the utility of Pocheron's invention, and insisted that he had not infringed the patent. He adduced numerous inventions which, as he contended, were to a greater or less extent anticipatory of Pocheron's invention. He referred to the provisional specification of a Mr. Beatson for improvements in the construction of furnaces, as strongly resembling Pocheron's invention. Mr. Beatson, however, did not appear to have made any practical use of it, or to have proceeded beyond the provisional specification. A Mr. Richardson had used a reverberatory tank furnace for making bottles for nine or ten weeks in 1836, after which the use of it was abandoned; and a good many witnesses were called with the object of impugning the utility of the patent.

Lord Justice Giffard said that he quite agreed with the authorities cited by Mr. Grove to the effect that a new trial ought not to be granted on light grounds. There must be something amounting to material misdirection by the Judge to the jury. In other words, the person who sought to have a new trial must make out that the matter was not fairly put to the jury. His Lordship then examined the original specification and the subsequent disclaimer of M. Pocheron at some length, and came to the conclusion that by the disclaimer that which was claimed as the invention was limited to the formation of the sides of the furnace hollow, for the purpose of introducing refrigerating currents of air. If the English language had any meaning, the disclaimer must mean that the claim was limited to that, and nothing else, and that everything else mentioned in the original specification was *publici juris*. Then came the question, how did the Master of the Rolls in his summing up represent the nature of the patent to the jury? His Lordship then, at considerable length, examined the summing up of the Master of the Rolls, and said that the result of it was that, whereas the patentee by his disclaimer said that he desired to limit his claim to the formation of the hollow sides, the Master of the Rolls told the jury that the invention comprised the whole combination mentioned in the original specification. This, in his Lordship's opinion, especially having regard to the evidence upon the issues put to the jury, was a very material misdirection. His Lordship was, therefore, of opinion that there must be a new trial upon all the issues.

Mr. Jessel, Q.C., then asked that the new trial might be heard before a different Judge.

Lord Justice Giffard said that no such order could be made unless the Master of the Rolls desired that the new trial should not be before him. Application must be made to him.

## REVIEWS OF NEW BOOKS.

*On Molecular and Microscopic Science.* By Mary Somerville. 2 vols. 8vo. Murray, 1869. With many illustrations.

It is, we might say, impossible that the lady who many years ago produced "The Mechanism of the Heavens," and "The Connection of the Physical Sciences," *could* produce a book that even a harsh critic dare justly pronounce a bad one. And even were such a possibility, he must have little of the deep feeling of homage for, and pride as an Englishman in, the career of his illustrious countrywoman, who could coerce his pen to trace in severity, any opinion if unfavourable, that he might form of this latest of her labours, the work of her old age. We may say this, for Mrs. Somerville has lived, and enjoyed, and we trust will yet long continue to enjoy life, in an atmosphere and at a level far above that of those of her sex to whom it is necessary to say that they never grow old.

Nevertheless, with all the splendid store of reading and observation, of mind-digesting and generalising power, the condensed, sparkling, and graphic style and diction of this work, we can scarcely in honesty say that we wholly like it. The idea that the authoress seems to have set before her own mind was probably that having given us in the "Mechanism of the Heavens," and in her "Physical Geography," two grand and sweeping panoramic views of the heavens above and of the earth beneath, and of the things most visible thereon; and having led us in the "Connection of the Physical Sciences" to behold the still greater glories of the results of human intellect, by which we have come to know so much as we do know of the heavens and the earth, she would now conduct us through the world of the unseen, at least by the unaided eye, the worlds of life in the indefinitely small.

But the task, if thus proposed, or even if much more limited, is vast, and though any one subject that can engage the attention of the naturalist needs lower powers and smaller intellectual apparatus than those of the astronomer or natural philosopher, yet is the vastness of detail of natural history, even in one of its departments, so great, and the uncertainties and blanks of complete knowledge here such, that any attempt at condensed and yet widely generalising panoramic scenery of the microscopic worlds of our own small planet, is a more difficult, if not hopeless task, than that loftier one that "doth glance from heaven to earth, from earth to heaven," and shows us in outline the great laws that govern the architecture of both alike.

In truth, natural history as yet, whatever to the contrary some natural historians may pretend, is but a huge, imperfect, incomplete, and probably to an extent that can be only fully known to generations that shall come centuries after us, erroneous compilation, and in its systematisation more or less of *facts*, most of them of a minute sort, requiring conditions to be stated, and subject to various circumstantialities and apparent exceptions, and often hard to connect, still oftener not capable of being largely generalised.

But this involves space, many words, big volumes, and just the class of subject-matter that either must be treated of superficially, and therefore incompletely if briefly, or spread out into much more than a survey *en ballon*, in two small volumes to be recorded.

Moreover, we cannot all of us, or any of us, be everything; not even the all-grasping and pervading genius of a Humboldt was sufficient to comprehend, evenly and fully, *everything* around us in the Cosmos, and as from a vantage coign above all others, to give his fellow-men a perfect and unchallengeable account of what he saw or thought he saw in that universal, and, as it were, apocalyptic vision. Probably no man who has become thoroughly conversant with any one domain of science reads Humboldt's great world survey, "The Cosmos," without discerning within the limits of his own, perhaps narrow but microscopically accurate information, that even in Humboldt's case *all* wisdom and knowledge is given to no man. Indeed there are parts of that grand work in which it has been said, with no more than truth, that its illustrious author has shown himself but—shall we say it plainly?—a smatterer.

Part the first of Mrs. Somerville's first volume, consisting of 166 pages, or nearly half the volume, is that which justifies the "Molecular" part of the title of the work. It is, in fact, a rapid and striking, and we need not say, most interesting sketch of the constitution of matter, i.e., of what we know of the chemical and physical relations of the world above and around us, with some of the great leading truths of chemistry, heat, light, electricity, &c. The sketch is somewhat unequally balanced in its parts, and here and there we might point out inaccuracies, especially in the chemical parts, as where (p. 123) it is said "Rosanaline or Roseine, a white substance, is *the base of* Aneline," or (p. 127) "among the products of the distillation of petroleum are naphthaline, whence Aneline is obtained;" indications that, as might be well supposed, the authoress cannot be equally accomplished in chemical as she has proved herself to be in mathematical and physical science.

This first part, however, which compresses within it nearly all the most recent discoveries in relation to light and heat, of a salient class, it is obviously in Mrs. Somerville's mind, shall be the fitting introduction to the second, which deals with vegetable organisms, and from the primordial cell and protoplasm takes us, *gradatim*, through the whole vegetable world, up to exogenous plants, involving of course the description—and the descriptions are often given in a very charming way—of many things of a size by no means microscopic, except in respect of their possible anatomy. But here, as we pass at once from the effects of light and heat upon vegetation, to this—primordial cell or protoplasm—we plump into that fathomless gulf which, let the natural historians and physiologists say what they will, and coin as many big new words, hiding ignorance under verbosity, as they please, still separates, and perhaps will for ever separate, that which we know or may know of the material world around us from that immaterial *life* outside it, and of which we know no more than that in divers forms it exists,

and presents us with various phenomena, which tend to repeat themselves.

The third part and third volume embraces the survey of animal organisms, beginning with Protozoa and ending with Mollusca.

Once fairly started at the commencement of her second part with unfolding her long but far from tedious scroll of natural history, and aided by multitudes of most exquisitely executed illustrations, with here and there a bit of philosophic commentary, or some unexpected suggestion of relation—the genuine offspring of a generalising and scientific mind—thrown in ; we have throughout the entire a work charming to the unlearned, as the Priestess reveals in brief the wonders the initiated may see within the veil of the Temple of Nature if they will enter for themselves, and to the already learned as calling up in successive pictures that which they have with delight already learned from other workers within the fane, or had revealed to their own askings of Nature.

In some senses this is a popular book, and with its lucid style and varied matter, so lavishly illustrated, ought to be popular with great numbers of those who know already some exact science and some natural history from systematic sources. But in the sense in which many, too many, books are called popular because merely consisting of a skin-deep sort of smattering, which shirks everything that may entail the least labour of thought upon the reader, who is to be amused and carried along by pretty pictures shaken before his eyes, like a baby's coral and bells—in this sense it will never be a popular book, other or more than Mrs. Somerville's precedent works, such as her "Physical Geography." And for this excellent reason, that our authoress, gifted as she is in accuracy of thought and lucidity of expression, coupled with happiness of illustration, writes up to her subject's interest and importance, and not down to her readers' possible ignorance.

To a certain school of men, and unhappily a too large one in our country, any very prominent notice of such a work as this on natural history may probably seem out of place in the pages of this Journal. If such there may be, if amongst our readers there be some of the "practical" school whose ideal value, in thought, in sitting at the feet of those of nobler mind or higher knowledge, is limited to what can be made out of it, into what gold will it coin, to such a one we can only say we pity him ; and not to moralise too much, we shall only venture to say this : just in proportion as any man's avocations whereby he wins bread for those dear and for himself, are *necessarily* onerous, unvaried, distasteful, or vulgarising in tendency, as all never-ending toil and care is, however successful in winning its reward in wealth, however just and brilliant that may be, so in the same proportion does every such man for healthful, mental life need some "fresh field and pasture new" into which he may turn, even in the perhaps scanty leisure from daily money-getting toil. There is none better than natural knowledge in some one or other of its endless paths. Thus—

> . . . . . there shall be
> Somewhere contentment for their human hearts,
> Some freshness, some unused material
> For wonder and for song. To lose oneself
> In other ways, where solemn guide-posts say,
> This way to knowledge—This way to repose.
> But here, here only I am ne'er betrayed,
> For every bye-path leads me to my love.

Such are the nature-sought experiences of James Russel Lowell, the American.

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*The Gold-Fields and Mineral Districts of Victoria ; with Notes of the Modes of Occurrence of Gold and other Metals and Minerals.* By R. Brough Smyth, F.G.S., Ass. I.C.E., &c. Melbourne, 1869.

This is a wonderful volume, descriptive of a wonderful country, and we may add people, for it would be vain not to see that English as they are by blood, the Victorians already begin to show the evident marks of a pullulating nationality. It almost takes one's breath away to read here the soberly composed, almost statistic account of their natural resources production and wealth, already in their national infancy acquired, and to contemplate what these and they must become within the next hundred years.

We wish we had space in this Journal to devote to a review worthy of the subject of this volume and of the volume itself, which in typography, style, paper and composition does the highest credit to Melbourne printers, and to the science, zeal and intelligence of the leading spirits of the great Colony which has produced this record of its greatness and progress.

No such ample, orderly, and clear account of gold-fields and gold-winning operations has ever before been given anywhere ; and the mining engineer or metallurgist seeking for information on these specialities, will find this, as we have done, the best source anywhere available.

A well-written introduction sketches the history of those circumstances which led to the production of the volume, in the course of which Mr. Smith, with a modesty which is surely more than needed, wishes it to be remembered that he is "merely a compiler" ; we can only say, we wish many of our home compilers, with far more pretension, had his orderly system, freshness, and intelligence. We here have a table of the gross produce of the gold-fields and mines of Victoria, from 1851 to 1868 inclusive, consisting of gold, silver, tin, copper, antimony, coal, lignite, kaolin, flag-stone, slates for roofing, magnesite, sapphires and diamonds, forming a gross total in money value of nearly one hundred and forty-eight millions sterling. Then follows a capital panorama of the mineral districts, in which we have occasional sketches of natural history, and, here and there, of some of its special Australian marvels, illustrated by beautifully executed woodcuts of trees and forest scenery ; which if they have been produced, as we presume they have, in the Colony, prove that the fine arts do not lag very far behind the rough race of the settler in his subduing and replenishing of the earth.

What glorious things some of these sketches show us ! Here, at p. 27, is the stump of a fallen Eucalyptus (*E. amygdalina*), throwing out tremendous ligneous buttresses at every side ; 69 feet in circumference at a little above the ground, and which was 330 feet in height. Which of us puny Londoners can adequately realise a single tree standing in St. Paul's Churchyard, shouldering at once the church and the houses around it, and rising high above the dome ? and yet, in this same forest of Dandenong, in one acre of ground, twenty trees, each above 350 feet high, were counted, thickly shouldering each other out of existence.

Many of the native timbers of Victoria, as those who examined them with any care when shown by sample in 1851 at the Great Exhibition, are superb in beauty of colour and feathery texture, infinitely more beautiful for furniture than the heavy cumbersome mahogany and walnut in which we delight here at home. It surely only needs some Jackson and Graham, or Gillow, to once start the fashion, and these lurid reds and ugly brown woods would soon give place to the golden sunny hues of furniture made of Australian timbers.

The Victorian colony, of about eighty-seven thousand square miles, consists, geologically, of granitic and plutonic rocks—Silurian, Devonian, and many rocks belonging to something between these limits, metamorphic or not. Newer carboniferous rocks, schists producing petroleum, &c. ; basalts and volcanic rocks ; tertiaries, including thin alluviums ; eruptive rocks and gold drifts ; limestones of various ages ; and unexplored formations, in about the following proportions superficially :—

| | | |
|---|---|---|
| Granites &c. . . . . | 2,200 | square miles. |
| Silurians to Devonians . . . | 28,000 | „ „ |
| Carboniferous . . . . . | 3,200 | „ „ |
| Basaltic and volcanic . . . | 10,300 | „ „ |
| Tertiary, with the gold drifts . . | 29,000 | „ „ |

and the remainder limestones of different ages, and unexplored country.

The gold-fields known to exist are estimated at a minimum of *twenty million acres*, of which not more than six hundred thousand have yet been opened or explored. They may be, therefore, said to be practically inexhaustible.

It was announced as long ago as 1788 that gold had been found in Australia, but the authority is vague, and nothing came of it. In 1850, news of gold being found here and there began to be bruited about, and in August 1851 a little girl picked up a small nugget of gold out of the mud of a street in Melbourne. In that year a reward was offered for the discovery of a workable gold-

mine anywhere within two hundred miles of that city; and before the end of the year almost a *stampede* of the whole adult male population of Geelong had gone off to the "diggings."

Scientifically the most valuable portion of this noble volume is its thick middle slice, extending to about two hundred and eighty pages; comprising the modes of occurrence of gold, with its chemical constitution as it is found, followed by ample details, and illustrated by first-rate maps and sections of the great distinctive divisions or forms in which it is found and wrought; viz., by surfacing and shallow sinking, by sluicing and hydraulic mining, by deep rib sinking, and by tunnelling, i.e. into the drift formation, and, lastly, by quartz-reef mining and crushing, which is, strictly, the only gold-mining proper, all the others being but more or less gigantic forms of operations, like our tin-streaming in Cornwall. In these admirable chapters there is comprised a mass of important geological and mining information of a strictly scientific character, as well as a body of practical knowledge of gold-getting in all its forms.

Men well capable of judging, indeed the best capable, dissent much from the (in many respects) crude and hasty views of some of our stay-at-home geological "great gun" authorities, as to the lithological and geological indications of gold; in fact, much of the "gold predictions" upon which a good deal of self-congratulation has been rested, seems to have been not much more than a lucky chance shot, at any rate does not contain the expression of any fact in nature. A complete catalogue of all the remarkable nuggets found since the commencement of the gold discoveries, with the weights given, follows these chapters, enough to make a miser's teeth water to read. The heaviest single "nugget" found was in weight about 184½ pounds troy, and the gold sold for above £9,300.

Besides gold the following metals have been already found in Victoria, viz.:—Osmi-iridium, which almost assuredly infers platina and its other attendant metals, silver, tin, copper, antimony, zinc, lead, cobalt, manganese, molybdena, and iron of course abundantly. Bismuth, latterly so rare in Europe, or so completely the subject of a close monopoly as to be at present worth about 18*s.* per pound avoir., has latterly been found in considerable abundance, and promises to become a valuable adjunct to European supplies. Messrs. Johnson and Matthey, of Hatton Garden, London, have smelted a good deal of it. Native sulphur has been found, though as yet not wrought. Sapphires and diamonds have been detected beyond doubt in the gold alluvium, and when more exact mineralogical knowledge and precise observation shall have been brought to bear upon these deposits, it can scarcely admit of doubt that many other gems and stones of beauty for fine-art purposes will present themselves. Alunite, gypsum, and salt have also been proved to exist; altogether a vision of future boundless wealth.

Those directly interested in mining operations and machinery will find in this volume the best account we have anywhere seen of the special machines and contrivances for gold-washing; and some of these curiously contrast with the machinery, with some gradually and constantly applied improvements, which has been in use in Hungary and the East of Europe for ages for like purposes, and which also curiously compares with the Russian contrivances adopted in the Oural.

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I. *Die hydraulischen Mörtel, insbesondere der Portland Cement, in chemisch-technischer Beziehung, für Fabrikanten, Bautechniker, Ingenieure und Chemiker.* Von Dr. W. Michaelis. Leipzig, 1869. 1 vol. 8vo., with numerous Illustrations.

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II. *A Practical Treatise on the Manufacture of Portland Cement.* By H. Reid, C.E. 1 vol. 8vo. Illustrations. Spon, London, 1868.

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III. *A Practical Treatise on Concrete, and how to make it.* By H. Reid, C.E. 1 vol. small 8vo. Illustrated. Spon, London, 1869.

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Mr. Reid has done well in entitling his two works above named practical treatises. They are so, and in their practical aspects must be hailed as an excellent and wanted contribution to the English technical literature of the architect and engineer. The second of the above works comprises a translation, stated to be not by Mr. H. Reid their author but by Mr. W. F. Reid, of the work on cements of Herr A. Lipowitz, chemist and technologist, which indeed occupies about half the volume. This, though it repeats a good many of the statements to be found from Mr. H. Reid in the prior half, is in itself a good and valuable systematic treatise. Of the style of the translation we are unable to speak in praise; in fact, both translator and editor (or author) appear about equally weak in their chemistry and their German—we might add also in their mineralogy or petrology—and the style of translation of M. Lipowitz' memoir is such as in many places to make it absolutely misleading or unintelligible to a mere English reader, who does not know enough of the subject beforehand to decipher or correct the mystical text as he goes along.

Such misspellings as Malagutti may be condoned, but what shall be said of the statement that :—

'The chief components of cements are—

| | | | |
|---|---|---|---|
| Chalk | from . . . . . | 50 to 60 | per cent. |
| Silicia | „ . . . . . | 10 „ 25 | „ |
| *Corundum* | „ . . . . . | 5 „ 10 | „ |
| Oxide of Iron | „ . . . . . | 4 „ 10 | „ |
| Magnesia | „ . . . . . | 1 „ 4 | „ |
| *Kali* and *Natron* | „ . . . . . | ¾ „ 4 | „ |
| Carbonic Acid | „ . . . . . | ½ „ 3 | „ |
| Sulphuric Acid | „ . . . . . | ½ „ 2 | „ |

or how is the English cement-maker to decipher this (p. 7) which follows :

"I do not recommend the introduction of alkalies into cement in the form of *Kali* or *Natron* combined with *Chlor* . . . . all cements containing *Chlor alkalies*, suffer most from the effects of weather, especially when combinations of magnesium occur in them;" in which, the *Chlor alkalies*, or the cement?

"This is not the case with *Kryolite*, which I consider a very good substitute for *Soda* or *Potash*," especially as it is so plentiful and come-at-able in its one known bed in Greenland.

At pages 9 to 12 we have a table intended to give the constituents of a number of "natural products" of a cement making character, and, not having the original German before us, we must confess ourselves fairly beaten by the titles of some of the amazing productions set down as "Substances analysed, and by whom."

The first of these is "Santorin," which we may guess to be something from the unstable volcanic islet of that name, but fail to recognise as any known mineral body; but who shall say what in mother English "Trachyttuffe Duckstone" may mean? Can it be meant for English to *Bimstein* or *Tufstein*? since the German *Ente*, a duck, seems far enough from either, and certainly nothing from the Rhine bears such an ornithological title.

Is the "Trachyte" of No. 5 the same thing as the above, or as the *Trachyt* with which in the notes it is declared to be identical? What may *Thouniern* (Nos. 16 and 17) be? surely it cannot be clay (*Thonerde*) nor can it be a bit of German and Swedish rolled up together (*Ierne*), for No. 17 only contains 0·6 per cent. of iron. What conceivable sort of thing may be the *Oxyhydrate* of iron of No. 28, the composition of which is set down at 20 to 60 per cent. of Si and Al (Silica and Alumina) with 20 to 89 per cent. of Fe (*metallic Iron*); no oxide or oxygen or water at all in this wondrous Oxyhydrate, new at once to chemistry and to its nomenclature in any country. We are fairly puzzled, and we fancy still more the "student," whose familiarity with this kind of thing may not be such as to enable him to guess out *Alumina* under the guise of *Corundum*.

But yet we should not perhaps have laid open such blemishes, were it not that we find Mr. Reid himself, in his volume on Concrete, tripping in very much the same sort of way. Take, for example, p. 16. "These cementitious volcanic products have received from mineralogists a variety of names, the more familiar of which are Pozzolana, *travantine* (*sic*) tufa, tufa-stone, trass angite! cencite! and andecite! besides other names having a purely local origin." However familiar the names may be, the things themselves are plainly most unfamiliar to our author.

Again, "Trass, or Tyrass (*sic*) has been favoured with a distinct classification by some authors," &c. (p. 16), or again, a more choice

speeimen on the same page: "Obsidian, pumiee, and pearlstone are *products* of the trachyt *formations*, and the analysis of the roeks *underlying* the Eifel mountains. Santorin and Vesuvius show a marked resemblance to those minerals," &e. We had just before been told that "the internal ageneies which produee voleanie aetion are exerted in *ejeeting portions of rock belonging to the Trachyt formation*, and at least in Italy and the Archipelago, from a submarine souree, sueh influence being assisted by the *simultaneous reduction of the land rocks, as is proved* by finding both at Vesuvius and the Eifel mountains organie remains;" the italies are ours. Whatever this may have been meant to mean, it will be new to Vuleanologists, and eonvey equally valuable information to them, and to the maker of eement.

"Campi Flegraei" (p. 21) ean seareely be a printer's blunder; nor "septeria" (p. 26), for the stones of Sheppey. In fine, Mr. Reid is obviously possessed of but the merest smattering of mineralogy or ehemistry, and would have eonsulted best the value of his works, as well as his own reputation, had he steered elear of the theoretic relations of his subjeets altogether, and eonfined himself to the praetieal details of eement and eonerete-making, testing, and employing for eonstruetive purposes, whether these were drawn forth from his own large and valuable experienee, or by compilation of faets from others; for he also proves himself well read in the history of his subjeets. In these respects his volumes may be eonsulted with pleasure and advantage, and should be so by every student as part of his information as to building eements.

The work of Dr. Miehaelis, which we have plaeed at the head of our list, is one of another type, and we are obliged to add, of very superior merit. We regret it is not yet available to the English reader—it well deserves translation.

Dr. Miehaelis has long devoted his keen abilities and aeeurate ehemieal and physical, as well as teehnologieal attainments to the investigation of the eonditions, better or worse, of produetion and of hardening of cements.

Some of his views have been the subject of keen eontroversy amongst the teehnical ehemists of Germany, and have in part been noticed and criticised some months ago in the pages of this Journal. His work, before us, "Hydraulischen Mörtel," is exact and exhaustive as regards the seientifie braneh of the subjeet, and is not deficient in the historieal and practical portions of it.

To those who want to get at onee at the best methods, as practised in Great Britain, of producing eement as an objeet of commeree, or for immediate use, as on large eontraets where the eireumstanees might make it worth while for a eontraetor to beeome his own eement-maker, or to know all about what the best British experience has dietated as to the employment and testing of cements, and who care nothing about theory—to all sueh we say, Mr. Reid's praetieal treatise is the most eopious and the most praetieal we have met with.

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*The Altered Relations of British and Foreign Industries and Manufactures—the Cause and the Cure—*

is a reprint in pamphlet form of an address delivered before the Royal Seottish Soeiety of Arts, November 8, 1869, by Mr. David Stevenson, C.E., President.

That there is a large amount of truth, and that of the most sobering charaeter, in the author's view that high wages in Great Britain as compared with those in other European nations is one great ause of our relative if not absolute loss of position in the raee of trade, may perhaps not admit of being controverted. But we think he attributes too much to that alone, and does not see very elearly a good many other points, all of which require to be taken into aeeount before one may logically venture to decry, as in general tendeney at least he does deery, the importanee of improved education, primary and technical, to our eountry's welfare in every aspeet of it.

There is a eertain narrowness of thought running all through the leeture; and it does not inspire additional confidenee, at this side of the Border at least, to find an educated engineer hauling in the Sabbatarian "rot"—we really ean at this time of day use no milder expression—through the help of the so-called reports of the "working men" sent over to the Paris Exhibition in 1867, under the pet tutelage of Mr. Cole and the Soeiety of Arts, Adelphi. Can any refleetive and unprejudieed man imagine that the reports of *sueh* men upon anything outside the eoncrete objeets of their respective trades, mueh less upon sueh great questions, as these "Daniels come to judgment" are here invoked to pronounee on, are worth the weight of one poor feather?

If there be any one proposition possible to be dedueed from Mr. Stevenson's views as to teehnieal edueation it is this, that it must be *very* limited, or too mueh time may be spent upon it to enable the lad to beeome a good workman.

Our notion is that, with immense advantage to the lad and the future man, might the mediæval period of *seven years* of his apprentieeship—a *servitude literally*, and not so mueh for the benefit of the apprentiee as of the master, one whieh dates from the enlightened days of Jaeob and Laban—should be shortened by from one-third to one-half, and that the dedueted time would be grandly well spent better in rudimentary, seientifie, and teehnieal edueation. The lad would then come to work nearer a man in thought, an instrueted and thinking lad, and not a mere animated machine, and his progress as a eraftsman would be quiekened, as if wings had been added to both his head and limbs.

There is no handicraft under the sun that any lad of ordinary eapaeity eannot aequire fairly within three years, if he be of steady habits and has been previously trained but a little to observe.

And after his three' years apprenticeship should have expired, what is the daily labour of his life but a continual edueation for further improvement in the praetiee of his eraft. To find men in the position of the author praetically opposing better edueation in our eountry, which is its most pressing want, is indeed sad, and shows that it is needed by those in seats of authority as well as in humbler walks.

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*Guide pratique de l'ouvrier mécanicien.* Par M. A. Ortolan, Chief Engineer in the French Marine. 1 vol. Small 8vo., with a small Atlas of 52 plates.

This is one of M. Lacroix' series of the *Bibliothèque des Professions industrielles et agricoles.* It does great eredit to both author and publisher. We fear there are few "first engineers" in the British fleet who eould write so terse, elear, and systematie a book for study and for handy referenee, even though helped, as is here the ease, by six engineers (one step below) of the Freneh Marine. It is an edueational book as well as one of referenee, and evidently designed for men who eannot earry a big library to sea with them. We have been very mueh pleased with the perspieuity and elearness with which the operations of Algebra, up to equations of the seeond order, are explained.

The ehapter on mensuration is not so good. We look in vain, for example, for a formula for the volume of a spherical shell—sueh as the egg-end of a boiler. The plates as eonstruetive examples are generally pretty fair. It is odd to remark here, as in many other French works of the sort, how the details of eonstruetion of the *bélier hydraulique* of Mongolfier—which ought to be viewed by Frenehmen as a national maehine, and henee all that is known about it elearly stated by them—are misrepresented, or in great part omitted.

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*Guide pratique d'Agrieulture générale.* Par A. Gobin.

This is another volume of M. Laeroix' "Bibliothèque," and an exeellent *abrégé* of the whole system of seientifie agriculture, from the eonsiderations of elimate and season and soil, to questions of labour, farming, eapital and profit. Possibly rather too mueh is attempted to be eompressed into a volume of about 450 pages.

The author, M. Goban, is Professor of Zooteehnics, and formerly sub-direetor of the model farm and agrieultural sehool, named in Franee the "Colonie pénitentiaire agricole," an exeellent institution, in whieh rural offenders for not very grave erimes are taught to work, and instrueted in the prineiples of rural labour, &e.

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# MONTHLY NOTES.

Croquet-Markers.—Mr. L. F. Banks, of the Royal Hospital, Kilmainham, Dublin, has recently devised and patented a novelty in croquet-markers. The markers are constructed in the form of a small tablet of ivory, or other suitable material, and are intended to be worn upon the person of each player, such tablet containing a miniature diagram of the "game," viz. the *direct* course of a hall from the starting peg to the winning peg, the positions of the hoops and pegs being indicated by holes made in the tablet in corresponding positions. Or a diagram of one half the "game" may be made on each side of the tablet. A small marking peg or pin, which may be of the colour of the player's croquet hall, is attached by a thread or fine chain to the tablet, such pin being composed by preference of whalebone, gutta-percha, or some slightly elastic material, so that, when inserted into any one of the holes in the tablet, it will remain secure therein. Should the player be playing two balls, then an additional pin of corresponding colour to the second hall will be employed. Arrows are marked on the tablets indicating the direction of the course of the player to and from the winning and starting pegs. In lieu of pins a slide or slides may be employed, or a hand or indicator used moving along the face or faces of the tablet, as required; or an adjustable sliding clip may be fitted on to the edge of the tablet with a raised stud in it, which drops into the different holes in the tablet. These tablets may be made small enough to be worn as "charms" on the watch chain if desired.

In the engraving, *a* represents a tablet consisting of a piece of flat ivory, bone, mother of pearl, coloured enamel, or other material. On this tablet is to be marked a diagram in black or coloured lines, or produced by inlaid metals representing the course of a croquet hall on its journey to the furthest peg from the "starting peg"; this will be virtually a diagram of half the game as shown in figure 2; but, if desired, a full diagram of the game may be given as shown in figure 1: along this

Fig. 1

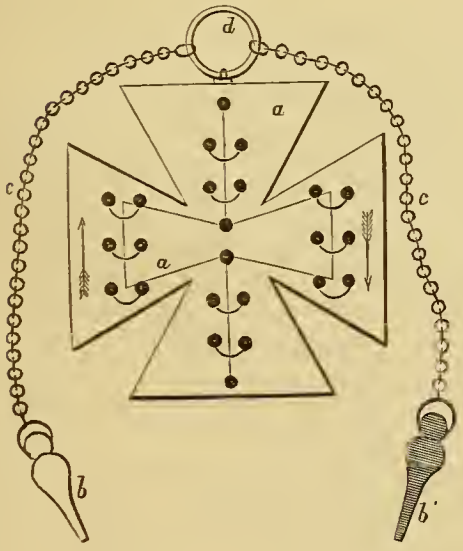
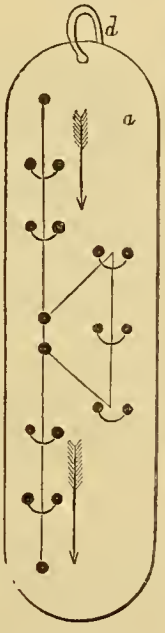



Fig. 2.




line the positions of the hoops and the middle peg are to be indicated by holes drilled right through as shown. It is obvious that similar lines drawn past the same holes on the reverse of the ivory tablet, figure 2, will show the return course of the hall to the "winning peg." The "position" of the player in the game, viz. the hoop through which his ball has next to pass, or the peg which it has next to strike, is to be marked by a small peg *b*, made to fit tightly into the holes in the tablet, which peg is to be inserted in the corresponding hole in the diagram on the ivory tablet or marker *a*, at one side or the other, according as the hall is going from the "starting peg" or returning to the "winning peg," the course on either side of the marker being distinctly shown by well-defined arrows pointing in the direction of the course, the peg being shifted by the player as the game advances. Should two balls be used by the one player, the position of the second hall may be marked in like manner by a second small peg *b'* fig. 1, of a different colour, or attached by a cord of a different colour, there being a second hole for the purpose in the marker. These small pegs *b* and *b'* are to be secured by pieces of chain, silk cord, or other suitable material, *c c'*, to the ring *d*, fastened to the end of the marker or tablet; by which ring it is to be suspended as a "charm" to the watch chain, or to a cord round the neck, or to a hook for the waistcoat button-hole, or otherwise carried on the person.

New Lighthouse Apparatus.—In the Lochindaal Lighthouse, in the Island of Islay, Argyllshire, which was exhibited for the first time on the 15th inst., Messrs. Stevenson, the engineers to the Northern Lighthouses, have introduced dioptric prisms of a new form. The following will sufficiently explain their nature:—The light which passes behind the flame has hitherto been sent forward by two optical agents, so as to mingle with the front light, and thus to reach the eye of the mariner; but the object is now effected for part of the upper cone of rays by means of the new prisms alone, so that one agent is saved, and the loss of light by absorption and superficial reflection is prevented. The prisms act by refraction and total reflection, and they consist of glass of the ordinary index of refraction. By means of these prisms, and a spherical mirror, the whole of the back light is sent forward. There can be no doubt that the Lochindaal prisms will come into general use in lighthouse illumination, the more so as they can be modified in various ways to suit the requirements of different localities.

Exportation of Steam-Engines.—The value of the steam-engines exported from the United Kingdom in the ten months ending October 31st last year was computed at 1,429,499*l.*, as compared with 1,470,171*l.* in the corresponding period of 1868, and 1,717,270*l.* in the corresponding period of 1867. The value of the steam-engines exported to Russia was largely increased last year, having risen to 294,284*l.*, as compared with 149,618*l.* in the corresponding period of 1868, and 65,189*l.* in the corresponding period of 1867. While the demand for English steam-engines (in which expression, we presume, we may include "locomotives") largely increased last year in Russia, it has declined in India, in consequence of the slackening which has taken place in the work of Indian railway construction. Thus in the ten months ending October 31st we only sent India steam-engines to the value of 241,496*l.*, as compared with 472,601*l.* in the corresponding period of 1868, and 811,961*l.* in the corresponding period of 1867. There was rather an improved demand last year for English steam-engines in Egypt and Australia, but a falling off occurred as regards France, Spain, and Brazil.

A Large Blast.—Recently, at the extensive lime quarries of Messrs. Briggs, situated at Salthill, near Clitheroe, one of the largest blasting operations ever attempted in that part of the country was successfully brought to a conclusion. At Salthill there is a perpendicular face of mountain limestone sixty feet in height. A tunnel, twenty-eight yards in length, had been bored in the face, and 60 cwt. of powder well walled in at the upper end. Three fusees were lighted at 2.20 p.m., and at 2.54 a mass of at least 50,000 tons of solid limestone was lifted perpendicularly a height of thirty or forty yards. So truly was the vertical movement effected that not a single stone was thrown to a distance of more than eighty yards. The huge mass went up together into the air, and, though crumbling in the descent, fell well together. Most of those present were scientific men, and afterwards dined together with Messrs. Briggs.

State Railways in India.—We have no desire to prophesy evil things of the new State Railways, and we sincerely wish the Government of India all possible success in the gigantic undertaking upon which it has just embarked. But we confess that, at present, appearances are the reverse of hopeful. If the first appointments are to be taken as specimens of the future management of the Department we can only anticipate a period of waste, blundering, and all the other evils attendant on official ignorance, inexperience, and inaptitude. Surely, Lord Mayo must have been in a peculiarly Irish mood when he started off the most daring experiment ever yet ventured on by an Administration with appointing to all the most responsible posts, men whose antecedents made it impossible that they should possess the most ordinary practical familiarity with the matters with which they are entrusted. What does Major Innes, who is to have charge of the Indus Valley Line, know about railway construction, beyond the very partial insight into railway matters that may be acquired by sitting in a first-class carriage? We may be wrong, but we are informed that not only has Major Innes never been engaged in any work of the kind, but that he is actually ignorant of the mere technical phraseology which is employed in railway engineering, and has still to learn, not only the practical working, but the very alphabet of his new profession. Captain Pollard, who, we hear, is to succeed Colonel Drummond, and will, therefore, we suppose, supervise Major Innes' proceedings, knows as much about the practical construction of railways as does his subordinate; while Major Williams, who, as Under-Secretary to Government in the Railway Department, will decide on the points submitted by the other two, is equally without practical experience of the matters upon which he will now be called to pronounce an authoritative opinion. To crown it all, the *Gazette of India* informs us that the Government actually intend disposing of the superseded police officers by employing them on the State Railways! Add to this that there will of course be the same wonderful exhibition of amateur engineering from Simla, that has been driving Mr. Lee Smith (the Government Engineer of the Peshawur State Railway) crazy for the last six months, we have, we think, as fair a prospect of gigantic mistakes, profligate waste, and ignominious failure, as the worst enemy of the new system could wish for.—*Indian Public Opinion.*

United States Navy.—It is stated that the Secretary of the Navy, in his forthcoming report, will recommend a total reorganisation of the United States navy, the sale of all the old and worthless vessels of the *Isherwood* class, and the construction of some new and more serviceable ships. The force of the navy now amounts to about 200 vessels. The Secretary will suggest that the peace footing be fixed at about 180 vessels. He is also in favour of subsidising lines of ocean steamers, and alludes to the advantages which the country would have derived in the late war from the possession of a steam flotilla, such as the British Government has as its disposal in the event of hostilities. The tonnage of England, France, and the United States is contrasted with, as may be judged, results by no means favourable to the United States. On the subject of docks and navy yards, the Secretary has some recommendations to make. He considers the Brooklyn yard too small, and will advise that ground be purchased on the North River for a more commodious establishment. The foreign squadrons, he thinks, should be increased and strengthened. All this can be accomplished on the same amount of money as was appropriated last year.

APPLICATIONS FOR

# PROVISIONAL PROTECTION FOR INVENTIONS

## UNDER THE PATENT LAW AMENDMENT ACT.

☞ When the city or town is not mentioned, London is to be understood.

*1st January* 1870.

1 C. Hodgson, Richmond—Compound riveted bands of iron, steel, or other metal to be used as a substitute for wire ropes
2 G. Goold, Handsworth, near Birmingham—Spoons
3 S. Holman, Laureace Pountney Lane—Apparatus for hinging, adjusting, and fastening gas retort lids, covers, or doors, and other lids, covers, and doors
4 R. A. Moll, Lombard Street—Suspension tramways or roads
5 J. Elce and R. Bond, Manchester—Self-acting temples for looms
6 G. Richardson, Manchester—Supplying baths and other places with hot water
7 H. Turner, Leicester—Weaving plain and elastic terry fabrics
8 W. R. Lake, Southampton Buildings—Harness for draught animals.—A com.
9 C. Drake, New Kent Road—Concrete buildings

*3rd January* 1870.

10 W. E. Gedge, Wellington Street, Strand—A novel construction of vehicle locomotive by human power.—A com.
11 F. J. Duggan, Bristol—Portable stoves, lamps, and lanterns
12 H. H. Cochrane, Stourbridge—Apparatus for working signals and switches on railways
13 E. Knowles and G. Hartley, Gomersal, near Leeds—Looms
14 J. Smith, Preston—Sickles and wires connected with mules for spinning
15 T. C. Olney, Manchester—Gas stove
16 W. R. Lake, Southampton Buildings—Wire ties for securing bales of cotton, hay, &c. A com.
17 W. E. Newton, Chancery Lane—Electro-magnets.—A com.
18 W. Cockburn, Glasgow, N.B.—Horse-shoes
19 W. Palmer, Bethnal Green—Lighting railway and other carriages
20 F. Foster, Islington—Instruments for measuring fluid or other pressure or weight
21 D. Forbes, York Place, Portman Square—Manufacture of artificial manures
22 C. Wyndham, Southover Grange, near Lewes, Sussex—Apparatus connected with bicycles

*4th January* 1870.

23 H. B. Barlow, Manchester—Machines for manufacturing fishing and other nets.—A com.
24 T. and R. Nuttall, Walmersley, Lancaster—Manufacture of counterpanes, quilts, quiltings, toiletings, &c.
25 E. C. Marie, Paris—Machinery for manufacturing mother-of-pearl, ivory, bone, or other hard buttons
26 T. Griffin, Pall-Mall—Attachments to be used with chains, cords, bands, &c.
27 J. Gordon, Dundee, N.B.—Manufacture of yarns
28 J. G. Tongue, Southampton Buildings—Processes for the purification of saccharine syrups.—A com.
29 W. H. Adcock, Kingstone Fields, Nottingham—Steam boilers and generators
30 E. Cottam, Wimbledon—Machinery for rolling bars for the manufacture of shoes for horses
31 C. H. Lea, Stafford—Apparatus to signal trains in foggy weather
32 T. Bannehr, Bermondsey—Propelling carriages, &c.
33 C. L. Thiery, Boston, Massachusetts, U.S.A.—Watch cases

*5th January* 1870.

34 C. W. Siemens and E. A. Cowper, George Street, and C. Cochrane, Upper Gornal, Stafford—Regenerative hot-blast stoves for heating air, steam, &c.
35 I. Baggs, High Holborn—Purifying coal gas
36 C. H. Westendarp, Lansdowne Road, and D. Dowling, Kennington Road—Breech-loading rifles
37 W. S. Lowe, New Mills, Derbyshire—Sizing machines
38 E. Edwards, Buckingham Street, Adelphi—Cocks and valves
39 Y. Duxbury, Hall-i'-th'-Wood Paper Works, near Bolton—Machinery used in making paper
40 R. Rundle and T. Parker, Idle, near Leeds—Heating churches, chapels, &c.
41 E. T. Truman, Old Burlington Street—Machinery for cleansing and preparing gutta-percha, india-rubber, &c.
42 L. C. W. Schütte, Dalston—Sugar-cane mills
43 H. Plummer, Brooklyn, U.S.A.—Sewing machines
44 W. Wharton, Liverpool—Spinning and manufacture of stick and roll tobacco
45 A. N. C. Gavard, Paris—Cartridge case for breech-loading firearms

*6th January* 1870.

46 J. Hargreaves and T. Robinson, Widnes—Treating sulphur, sulphide of hydrogen, pyrites, and other compounds of sulphur
47 G. D. Kittoe and P. Brotherhood, Clerkenwell—Packing of pistons, glands, pipe and other joints
48 W. Weild, Manchester—Machinery for winding yarn or thread on to bobbins, spools, &c.
49 J. Michels, Barnes, Surrey—Fastening and unfastening the doors of railway carriages
50 G. Shand, Stirling, N.B.—Obtaining products from mineral and vegetable tars
51 J. J. Miller, Camberwell—Apparatus for reversing marine and other large steam engines
52 P. Jensen, Chancery Lane—Closing or fastening neckties, stocks, cuffs, &c.—A com.
53 C. East, Kettering—Boots and shoes
54 J. H. Johnson, Lincoln's Inn Fields—Heating apparatus.—A com.
55 A. B. Ibbotson, Sheffield—Joints for uniting and securing the ends of railway rails

*7th January* 1870.

56 W. J. Purcell, Strathroy, Middlesex, Canada—Moistening the sheets of a letter-book and copying paper
57 H. Pritty, Chelsea—Damping copying paper, stamps, labels, &c.
58 R. Morris, Doncaster, and M. D. Penney, Stockwith-on-Trent—Treating shoddy and other animal waste to obtain ammonia and salts of ammonia therefrom
59 W. R. Lake, Southampton Buildings—Lawn mowing machines.—A com.
60 J. Gamgee, Bayswater—Effecting the preservation of animal substances
61 J. Carnaby, High Holborn—Dials, &c.
62 T. Coltman, Leicester—Manufacture of looped or knitted fabrics
63 G. G. Tandy, Penge, Surrey, J. A. Dryden, Stewart Lane, Surrey, and W. Perkins, Herne Hill Road, Surrey—Preparation of combustible liquids for illuminating purposes, &c.

*8th January* 1870.

64 B. Brown, Bury, Lancaster—Spinning and doubling cotton, &c.
65 G. Little, Oldham—Combing cotton, wool, &c.
66 J. H. Robinson, Gracechurch Street—Ships.—A com.
67 W. H. Hughan, Newton Stewart, N.B.—Treatment of night soil, sewage, &c.
68 H. W. Lowden, Douglas, Isle of Man—Self-gauging and registering indicator for ascertaining the hourly, daily, or periodical consumption of liquids of any kind
69 A. M. Clark, Chancery Lane—Spring seats, chairs, and mattresses.—A com.
70 W. Thomson, Glasgow, N.B.—Bending and otherwise operating upon metals, &c.
71 G. H. Bass, Featherstone Street—Teapots and other vessels intended to contain hot liquids

*10th January* 1870.

72 C. D. Abel, Southampton Buildings—The treatment of cast-iron for the production of castings therefrom.—A com.
73 W. G. Cunningham, Stonehouse, Devon—Cleaning and polishing boots and shoes
74 W. W. Hughes, Bayswater—Furnaces
75 J. H. Johnson, Lincoln's Inn Fields—Bleaching wool and silk—A com.
76 H. M. Richardson, Barnsley—Lamps

*11th January* 1870.

77 A. Cochran, Kirktonfield, N.B., and J. Kerr, Neilston, Renfrew—Apparatus for discharging water from steam-pipes
78 J. E. Lipscombe, Salford—Filters
79 E. Gaillet, Paris—Ploughing
80 E. A. Chameroy, Paris—Gauging or regulating the flow of water &c.
81 J. H. Johnson, Lincoln's Inn Fields—Apparatus for puddling iron.—A com.
82 O. Vivier, Sekforde Street—Measuring and indicating the distances travelled by vehicles
83 C. M. Wade, Furnival's Inn—Switch apparatus for operating the points and crossings of the permanent way of railways.—A com.
84 W. Campion, Nottingham—Sewing machines
85 R. D. Dwyer, Gracechurch Street—Roofing buildings
86 R. D. Dwyer, Gracechurch Street—Self-closing tap for drawing off liquids
87 W. R. Lake, Southampton Buildings—Apparatus for sharpening knives.—A com.

*12th January* 1870.

88 H. T. Humphreys, West Limerick—Constructing railroads with jaunting cars and posts and railways
89 T. G. Hemery, Bruton Street—Photography
90 B. J. B. Mills, Southampton Buildings—Tramways, &c.—A com.
91 F. H. Knevitt, Sun Court, Cornhill—Shutters and blinds for windows, doorways, &c.
92 H. Jones, Birmingham—Breech-loading firearms
93 L. Sterne, Great Queen Street, and J. G. Warner, Kensington—Bolts for securing parts of the permanent way of railways
94 A. A. Hely, Buckingham Street, and J. Marshall, Poplar—Apparatus for facilitating human locomotion
95 J. Ambler, Leeds—Machinery for twisting woollen, flax, cotton, &c.
96 W. Denison and H. Teall, Leeds—Steam-engines
97 W. H. Balmain and W. J. Menzies, St. Helen's, Lancaster—Conveying and storing vitriol
98 W. E. Newton, Chancery Lane—Manufacture of sugar.—A com.
99 W. Goreham and L. White, Swanscombe—Portland cement
100 G. Kent, High Holborn—Rotary knife cleaning and polishing machines
101 A. B. Ibbotson and J. A. Lindblad, Sheffield—Rails, chairs, and joints for the permanent way of railways
102 A. Clark and A. V. Winkle, Great Wild Street—Machines for bottling soda water, &c.—Partly a com.
103 H. E. Newton, Chancery Lane—Billiard-table cushions.—A com.
104 A. V. Newton, Chancery Lane—Apparatus for preparing fibrous substances for spinning.—A com.
105 A. V. Newton, Chancery Lane—Knitting machine.—A com.
106 A. V. Newton, Chancery Lane—Machinery for preparing fibres for spinning.—A com.

*13th January* 1870.

107 J. Taylor, Saltaire, near Bradford—Machinery for combing wool
108 J. Greenshields, Glasgow, N.B.—Obtaining oil from carbonaceous substances, &c.
109 J. Cross, Whitehaven—Frames of umbrellas and parasols
110 W. F. Chapman, Llandudno—Apparatus for transmitting and exhibiting cut flowers
111 E. Leigh, Manchester—Permanent way of railways
112 J. Wright, J. Cryer, and E. Rhodes, Shipley, near Leeds—Exhibiting names, photographs, views, designs, or sketches in monuments, door or other knobs, boxes, walking-sticks, umbrellas, &c.
113 G. Thorneloe, London Wall—Flexible valve
114 J. Lusty, Ipswich—Feed mechanism for sewing machines
115 A. B. Ziescbang and F. L. H. Schmidt, Nicholas Street, St. Peter's Road—Breech-loading firearms
116 T. Restell, Birmingham—Breech-loading arms and cartridges, &c.
117 W. Thornley, Little Lever, S. Spencer, Prestolee, Lancaster, and J. Wright, Gresford, Denbigh—Furnaces

*14th January* 1870.

118 J. Leetch, Broadley Terrace, Blandford Square—Apparatus for effecting communication between the different parts of a railway train in motion
119 P. Nisser, New Road, Whitechapel—Simplified explosive substitute for gunpowder
120 E. Cottam, Wimbledon—Pipes for smoking
121 W. Sinton, Jedburgh, N.B.—Churns
122 H. A. Bonneville, Sackville Street—Warming and ventilating close carriages and boat saloons.—A com.

*15th January* 1870.

123 A. C. Jonais, Chaux-de-Fonds, Switzerland—Double-faced watches
124 J. Wadsworth, Manchester—Steam and other boilers
125 M. Anderson, Camden Town—Apparatus for preventing the downward draught in chimneys
126 W. F. Reynolds, Albert Square, Commercial Road—Ships' logs and sounding machines
127 J. Watson, Oldham—Feed motion of sewing machines
128 T. R. H. Fisken, Leeds—Machinery for breaking and softening flax, &c.
129 J. Robinson and J. Smith, Rochdale—Apparatus for cutting wood into shreds or shavings to be used in the manufacture of paper

130 A. M. Clark, Chancery Lane—Wooden pavements.—A com.
131 E. J. Jeffs, Hammersmith—Apparatus for recording the number of passengers who travel in omnibuses, or other vehicles, &c.
132 E. G. Wrigley, Broadoaks, Bury—Rag-engines
133 F. G. Fleury, Merrick Square, Southwark—Apparatus for drawing or raising and forcing liquids
134 G. Lampen, Wylam, Northumberland—Shot

17*th January* 1870.

135 T. Welton, 13 Grafton Street, Fitzroy Square—Stoppers for jars, carboys, bottles, casks, &c.
136 T. Taylor, Pilsworth, Lancaster—Apparatus for the prevention of smoke in steam boiler and other furnaces
137 F. S. Lines, Birmingham—Ornamenting surfaces
138 G. Baker, Birmingham Heath—Machinery for cutting splints
139 A. B. Rocke, Upper Thames Street—Knobs and spindles for door locks, &c.
140 A. R. Gibbons, Old Change, and A. Umbach, Lebbon Street—Apparatus for ornamenting or embroidering fabrics
141 T. Peard, J. J. Castle, and I. Holmes, Wych Street—Apparatus for adjusting and securing the knobs or handles of locks, latches, &c.
142 J. Richardson, Pocklington, York—Artificial manure

18*th January* 1870.

143 T. B. Hubbell, Kentish Town—Gas burner.—A com.
144 W. Richards, Birmingham—Breech-loading firearms and cartridges
145 H. B. Barlow, Manchester—Machines for sizing yarn.—A com.
146 H. B. Read, City Road—Wrapping rug
147 H. Haines, Liverpool—Lead-encased tin pipes
148 T. C. Sloggett, Plymouth—Preserving meat, &c.
149 H. W. Hammond, Manchester—Continnal lever, for changing alternate rotary motion into continnous rotary motion, and vice versâ.—A com.
150 G. G. Bnssey, Peckham—Giving flight to the toy known as the Ariel top
151 T. Whitehead, Leeds—Wool combing and drawing machinery
152 J. Mackenzie, Edinburgh, N.B.—Apparatus for coupling railway carriages
153 J. H. Johnson, Lincoln's Inn Fields—Treatment of acid tars obtained from Boghead mineral, schist, or petroleum.—A com.

19*th January* 1870.

154 T. P. Balls, Cardiff—Apparatus for moulding and compressing substances for artificial fuel
155 W. H. Sleigh, Manchester, and J. Richardson, Salford—Apparatus to be employed for sharpening scissors, knives, &c.
156 W. F. Padwick, Blaenan, Merioneth—Fire grates
157 E. T. Hughes, Chancery Lane—Apparatus for diminishing the effects of the oscillation of vessels, and for preventing sea sickness.—A com.
158 B. Clarkson and S. Charlton, Manchester—Scale beams
159 E. T. Hnghes, Chancery Lane—Looms.—A com.
160 C. Gordon, Goswell Road—Breech-loading firearms
161 J. G. Tongue, Southampton Buildings—Governors for regulating the speed of prime movers.—A com.
162 W. Mawe, Doncaster—Safes and strong rooms
163 J. Dewar, Kirkcaldy, N.B.—Manure
164 J. A. D. Cox, Notting Hill—Composition to be mixed with white lead and other pigments in lieu of linseed or boiled oil, turps, and dryers, to form paint
165 H. Ashworth, Walsden, Lancaster—Apparatus for spinning and doubling cotton, &c.
166 E. Wood, Bolton—Steam-engines
167 J. C. Ramsden, Bradford—Apparatus for producing a piled surface
168 W. Mavitta, Handsworth, Stafford—Sights for firearms and ordnance
169 P. Currie, Birmingham—Hat and coat hooks
170 D. Servante, jun., Charlton Crescent—Printing machinery
171 J. J. Richardson, Leeds—Apparatus for pointing or grinding hackle, gill, card, or other pins and teeth used in machinery for preparing woollen, cotton, flax, or other fibrous snbstances

20*th January* 1870.

172 G. H. Gossip, Haggerstone—Umbrellas and parasols
173 G. H. Ellis, Gracechurch Street—Ladders
174 W. Noton, Oldham—Carding engines
175 J. M. Kilner, Chester Castle—Apparatus for the passage and control of cables and other chains
176 C. Cochrane, Upper Gornal, Stafford—Preparation of iron ores for smelting, &c.
177 G. E. Fawcus, North Shields—Refining lead
178 C. A. Calvert, Manchester—Apparatus for self-registering and checking the money taken for admissions to public entertainments, &c.
179 W. L. Wildy, Regent's Park Road—Steam-engines
180 D. Spill, Hackney—Treatment of xyloidine
181 W. Simons and A. Brown, Renfrew—Apparatus used for dredging purposes
182 W. R. Lake, Sonthampton Buildings—Needles and needle-arms for sewing machines. A com.

21*st January* 1870.

183 F. Rötig, Havre—Watches
184 W. E. Gedge, Wellington Street, Strand—Preserving bread in a reduced bulk.—A com.
185 M. Anderson, Leith, N.B.—Discharging grain from ships, &c.
186 J. Reichel, Berlin—Buttons and clasps for linen and other garments
187 F. Whitfield, Birmingham—Locks
188 T. J. Smith, Fleet Street—Cleansing, drawing, and tinning wire.—A com.
189 F. C. Sonthwell, Rugeley—Chaff-cutters
190 W. E. Newton, Chancery Lane—Preparation of various natural snbstances so as to render them applicable for use in journal boxes and other parts of machinery, &c. A com.
191 F. Hocking, Broad Street, Ratcliff—Fastening the leaves in music, periodicals, and books
192 W. R. Lake, Sonthampton Buildings—Toy air-gun and projectile for the same.—A com.
193 A. M. Clark, Chancery Lane—Chains and chain cables.—A com.

22*nd January* 1870.

194 J. M. Plessner, Golden Square—Liquid fuel
195 J. Macqneen, Manchester—Self-acting mules
196 J. Paton, Paisley, P. and R. Harris, Glasgow, N.B.—Apparatus for generating carbonic acid gas for application to the extinction and prevention of fire
197 R. Fielden, jun., and T. Fielden, Walsden, Lancaster—Pickers for looms
198 F. Sleigh, Wakefield Street—Imparting elasticity and strength to chain cables of ships
199 J. Dawson and T. C. Fawcett, Leeds—Raising gigs used in the process of raising the nap of woollen cloth, &c.
200 W. H. Berry, G. Jowett, and J. Wood, Sowerby Bridge—Water or other liquid or fluid meters
201 J. R. Johnson, Rathbone Place—Preparation of paper or other surfaces for the production or manufacture of pictures by photography
202 H. M. Whitehead, Lime Street Square—Preparing blocks of animal and vegetable materials for making soup or other liquid food
203 W. T. Waite, Southampton—Preparation of animal charcoal for use in treating saccharine solutions
204 W. T. Waite, Southampton—Filtering saccharine solutions and other liquids
205 W. Garton, Southampton—Preparation of fermentable saccharine matters
206 W. Dennis, Aldermanbury—Letter boxes, letter pillars, &c.
207 A. M. Clark, Chancery Lane—Electro motor for sewing machines.—A com.
208 F. A. Barrow, Glasgow, N.B.—Apparatus for evaporating and concentrating liquids
209 A. S. Campbell, Hampstead—Appliance for facilitating the working of bicycles and tricycles
210 J. W. Eyres and J. Longbottom, Leeds—Ornamenting woven and felted fabrics
211 W. Warren, Jersey—Ships' anchors
212 J. Holdsworth, Kingston-upon-Hull—Apparatus and mechanical means for excavating, filling in, transporting, and discharging grain, seeds, &c.
213 W. R. Lake, Southampton Buildings—Mowing and reaping machines.—A com.

24*th January* 1870.

214 R. Boyd, Strand—Bells.—A com.
215 W. R. Lake, Southampton Buildings—Apparatus for operating railway switches.—A com.
216 R. S. Dale and C. Schorlemmer, Manchester—Preparing colouring matters
217 T. Bentley, Margate—Apparatus for decanting liquids
218 W. E. Gedge, Wellington Street, Strand—Apparatus for lubricating parts of locomotive and other engines.—A com.
219 F. Kohn, Robert Street, Adelphi—Extracting juices from plants, and separating liquid or soluble matter from solids.—Partly a com.

25*th January* 1870.

220 G. E. Harding, New York, U.S.A. and P. Wright, Glasgow, N.B.—Knitting machines
221 J. H. Johnson, Lincoln's Inn Fields—Applying anti-friction rollers to wheels and other parts of machinery.—A com.
222 G. C. Philcox and T. Saint, Goswell Street Road—Marine chronometers, watches, and other time-keepers
223 J. Skertchly, Margaret Street, Wilmington Square, and A. M. Hurst, Arthur Street West—Manufacture of tablets, facias, signs, &c.
224 W. Hunter, Glasgow, N.B.—Looms
225 H. B. Greenwood, South Hackney—Electric telegraphs
226 R. A. Whytlaw, Watling Street—Apparatus for feeding steam-boilers with water.—A com.
227 J. Strain, Neilston, Renfrew, N.B.—Pipe joints
228 C. F. Varley, Beckenham, and T. A. Rochussen, Abchurch Lane—Producing heat and light
229 G. A. Buchholz, Regent's Park—Manufacturing semolina and flour
230 W. S. Underhill, Newport, Salop—Steam-engines
231 A. V. Newton, Chancery Lane—Meters.—A com.
232 F. J. Barnby, Hull—Floor cramps

26*th January* 1870.

233 W. G. R. Penley, Holloway—Pipes for smoking tobacco
234 W. Hay, Glasgow, N.B.—Making paper
235 W. R. Lake, Southampton Buildings—Furnace grates.—A com.
236 W. E. Newton, Chancery Lane—Preparing surfaces for skating in all seasons.—A com.
237 C. Lungley, Greenwich—Ships or vessels
238 J. B. Alliott and A. H. Sellers, Nottingham—Axle-boxes
239 M. Anketell, Ealing, and O. F. Anketell, Ladbroke Square—Manure
240 W. F. Dearlove, Judd Street—Apparatus for chopping or mincing animal, vegetable, and other substances
241 W. J. Coleman, Bury Saint Edmunds—Treating sour beer to remove its acidity

27*th January* 1870.

242 S. Lewin, Poole—Elevators for raising and stacking straw, hay, &c.
243 G. Leach, Leeds—Shipping and unshipping auxiliary screw propellers whilst in deep water
244 J. W. Currier, Newbury, Vermont, U.S.A.—Connecting traces to carriages
245 J. H. Kidd, Bangor Iscoyd, Flint—Wheels for vehicles
246 J. S. James and H. Wilson, Belvedere Road—Machines for putting together the parts of cart and other wheels
247 A. D. and J. W. Brown, Bristol—Apparatus for cutting curved and irregular forms
248 J. B. Smith, Bishopsgate Street—Improvements in permanent way, and in wheels to be used therewith.—A com.
249 W. H. Adcock, Kingston Fields, Nottingham—Apparatus employed for heating water and other liquids
250 O. C. Mootham, Bournemouth—Umbrellas, parasols, and sunshades

28*th January* 1870.

251 W. R. Lake, Southampton Buildings—Lawn mowing machines.—A com.
252 B. Conci, Paris—Mechanic scaffolding, applicable to buildings, fires, salvage in fires
253 J. Ricketts, Liverpool—Taps or cocks
254 R. Haworth, Manchester, E. Woodcock and J. McCabe, Salford—Looms
255 J. E. Standfield, Exeter—Four-wheeled carriages
256 A. W. G. Weeks, G. Deal, G. Lillywhite, and A. O. Launders, Chelsea—Hot-water boilers, joints, and valves
257 J. C. Haddan, Brixton—Apparatus for taking and registering votes
258 J. Rigby, Wednesbury—Coach or carriage axles
259 E. S. Cathels, Lower Sydenham, and D. Terrace, De Beauvoir Town—Manufacture of gas—(Com. spec.)
260 J. Dewar, Kirkcaldy—Treatment of substances for food and manure
261 W. R. Lake, Southampton Buildings—Spinning wool.—A com.
262 R. H. Durie, Tranent, N.B.—Braking or retarding railway trains
263 G. Thornhill, Glasgow, Lanark—Hats
264 W. Orr, Kilmarnock, N.B.—Ornamenting Scotch caps or bonnets
265 A. M. Clark, Chancery Lane—Currying leather—A com.
266 C. H. Perman, Birmingham—Hinges
267 H. J. West, Sonthwark—Refrigerating for the manufacture of ice and other purposes

29*th January* 1870.

268 W. White, Glasgow, N.B.—Wearing apparel
269 A. H. Brandon, Paris—Breech-loading firearms—A com.
270 S. W. Mnlloney, Coventry, Warwick—Weaving seamless articles

31*st January* 1870.

271 J. Hodgson, Queenhithe—Railway time-tables
272 R. Dick, Glasgow, N.B.—Covering and insulating the wires of electric telegraphs
273 A. Paget, Loughborough, Leicester—Hooks
274 T. Walker, Chelsea—Improvements applicable to telegraphic purposes
275 T. B. Kay, Bolton, Lancaster—Carding engines
276 T. Lee, W. Lee, and E. Lee, Chester—Mill bills
277 O. E. Pohl, Liverpool, Lancaster—Ships, sliding keels and appliances
278 J. Clark, Cambridge—Muffs, ladies' collars, trimmings, &c.
279 W. R. Lake, Southampton Buildings—Apparatus for producing rotary motion—A com.—(Com. spec.)

280 E. Brasier, New Cross, Surrey—Machinery for breaking, heckling, streaking, and cleaning hemp, cleaning flax, tow, washiug wool, &c.
281 C. Mahler, San Francisco, California, U.S.—Windmill, which can also he used as a water-wheel or ship's propeller
282 F. Clandet, Coleman Street—Treatment of cupreous ores containing silver—(Com. spec.)
283 J. H. Johnson, Lincoln's Inn Fields—Sewing machines.—A com.
284 J. H. Johnson, Lincoln's Inn Fields—Motive-power engines, and steam generators—A com.—(Com. spec.)
285 A. Werkmeister, Berlin, Prussia—Universal liquid meter

*1st February* 1870.

286 J. Bullough, Blackburn, Lancaster—Looms
287 B. Latchford, Upper Saint Martin's Lane—Manufacture of spur boxes
288 E. Dutasta, Bordeaux and Paris—Hygienic hat-cover
289 R. Boyd, Strand—Weighing machines.—A com.
290 T. Markland, Manchester—Hydro-extractors
291 C. W. Fuller, Gracechurch Street—Bottles to contain aërated and other liquids, and stoppering the same
292 J. and H. Fisher, Birkenhead, Chester—Furnaces
293 J. E. H. Gordon, Strand—Communicating the direction of the wind from a vane to a dial or apparatus hy electric wires
294 W. R. Lake, Soutbampton Buildings—Sewing-machine needles and needle arms.—A com.—(Com, spec.)
295 G. Broadhurst, J. Swindells, and J. Kershaw, Manchester—India-rubber manufactures, and tools employed therein
296 H. Collins, St. Alban's, Herts—Safety cage for children
297 A. G. Coes, Worcester, Massachusetts—Wrenches.—(Com. spec.)
298 D. Robertson, Clackmannau, N.B.—Carding engines.—(Com. spec.)
299 C. Vero, Atherstone, Warwick—Manufacture of hats and caps
300 F. R. W. Hedges, Bow—Mortising machines

*2nd February* 1870.

301 N. J. Holmes, Primrose Hill Road—Signal lights for marine and other purposes.—A com.
302 W. Hartley, Bradford, York—Manufacture of paper hags
303 I. Adams, junr., Massachusetts, U.S.A., now of Chancery Lane—Effectiug the electro deposition of nickel
304 B. Hunt, Lincoln's Inn—Watches.—A com.
305 W. R. Lake, Southampton Buildings—Automatic apparatus for producing carbonic acid for the manufacture of effervescing or gaseous liquids.—A com.
306 C. Kinzler and A. Keppler, New York—Propellers—(Com. spec.)
307 J. P. Pritchell, Darlington, Durham—Fireplaces or stoves
308 A. M. Morc, Euston Road—Compouud and process for eliminating diseases and the cause of disease
309 W. R. Lake, Southamptou Buildings—Revivifying animal charcoal.—A com.
310 A. W. T. Baker, Birmingham, and Totteuham Court Road—Nails for coffins, articles of furniture, and other nses
311 W. J. Hodge, Southwark, Surrey, aud J. W. Greayer, Bow—Ohtaining motivepower hy means of steam

*3rd February* 1870

312 W. Shann, Pateley Bridge, Yorkshire—Breaking hemp, flax and jute
313 C. Gordon, Goswell Road, Middlesex—Breech-loadiug firearms
314 B. J. B. Mills, Southampton Buildings—Fans.—A com.
315 J. H. Johnson, Lincoln's Inn Fields—Gas and other pressure regulators.—A com.
316 J. Davenport, Pittenweem, Fife, N.B.—Riddle for cleansing and assorting potatoes
317 A. V. Newton, Chancery Lane—Treating iron.—A com.
318 A. V. Newton, Chancery Lane—Manufacturing wrought-iron or steel.—A com.
319 W. R. Lake, Southampton Buildings—Friction cluteh.—A com.
320 W. R. Lake, Southampton Buildings—Spring bed bottoms.—A com.
321 W. R. Lake, Southaupton Buildings—Mowing grass.—A com.—(Com. spec.)
322 A. M. Clark, Chancery Lane—Printing presses.—A com.

*4th February* 1870.

323 J. Sellers, Cleckheaton, York—Apparatus for effecting calculations
324 J. Thomas, Birmingham—Breech-loading firearms
325 W. E. Gedge, Wellington Street—Manufacture of boxes, cases, and analogous articles—A com.
326 A. V. Newton, Chancery Lane—Knitting machines.—A com.
327 H. E. Newton, Chancery Lane—Machinery for cutting, dressing, or working stone. A com.
328 A. Le Brun-Virloy, Paris—Treating iron ores
329 J. Willis and J. Southall, Norwich—Cutting leather for the soles and heels of boots and shoes
330 T. J. Smith, Fleet Street—Manufacture of chairs.—A com.

*5th February* 1870.

331 W. Whieldon, Westminster Bridge Road—Kneading and mixing machines
332 G. E. Harding, New York, U.S.—Improved device for imparting a variable reciprocating motion
333 G. Holmes and J. Wiutertou, Nottingham—Manufacture or production of gloves
334 M. Stell, Bradford, York—Spinning, twisting, or doubling worsted or other fibrous substances
335 W. Snaydon, Corscombe, Dorset—Brakes for two-wheel carriages
336 J. Knowles, Bolton, Lancaster—Self-acting mnles for spinning and doubling
337 H. Gardner, Islington—Machinery for preparing flax, and for the preparation of the grass known as "crin"
338 W. T. Shaw, Manchester—Preparing lard
339 L. Meyer, Paris—Button or fastening for ruffles
340 H. Wittöft, Copenhagen, Denmark—Gas burners
341 F. Sangster, Lee, Kent—Parasols and umbrellas
342 G. Tyler, Cheapside—Fasteners for securing made-up scarves, neck-ties, belts, sashes, or other articles of wearing apparel

*7th February* 1870.

343 G. T. Tietjen, Kentish Town—Adjusting the bodies and shafts or poles of vehicles to suit the height of the animals employed to draw them
344 H. Brooks, A. Brooks, T. Bestwick, and W. Bestwick, Manchester—Machinery for covering telegraph wires
345 J. T. Greenfield, Dover, Kent—Life-buoys
346 W. B. Woodbury, Fulham, Middlesex—Producing surfaces hy the aid of photography
347 J. Ramsbottom, Leeds, York—Apparatus for registering the number of games played at billiards
348 H. G. Pendleton, Birmingham, Warwick—Chain suspender and fastener, applicable for attaching brooches, studs, clasps, links, huttons, and articles of jewellery, &c. to the dress of the user
349 G. Dumont, Belgique—Treatment of argentiferous leads
350 S. Bremner, Farringdou Street—Feed apparatus for printing machines
351 H. Wedekind, Great Tower Street—Straightening, stamping-out, shearing, and otherwise shaping and treating iron, steel, copper, and other metallic plates and sheets—A com.
352 J. Taylor, Fakenham, Norfolk—Apparatus for ploughing, harrowing, or cultivating land
353 J. Hanson, Rashcliffe—Breech-loading firearms and cartridges
354 H. Hughes, Homerton—Trimmings or edgings
355 J. S. Dronsfield, Lancaster—Apparatus for grinding the card-covered surfaces of portions of carding-engines
356 B. Walker and J. F. A. Pflaum, Leeds, York—Clutches for engaging and disengaging parts of machinery

*8th February* 1870.

357 J. Kenyon, Blackburn—Pickers for looms
358 J. Ward and J. Bowing, Broad Street Buildings—Preparing and drying yeast
359 H. Bond and G. Riley, Bolton, Lancaster—Manufacture of quilts, counterpanes, table- or toilet covers, and other similar fabrics
360 D. Rorison and R. G. Finlay, Glasgow—Looms
361 S. W. Thomas, Southease—Bicycles
362 C. D. Ahel, Southampton Buildings—Apparatus for taking soundings at sea—A com.
363 A. Field, Brentford, and E. Badger, Kingsdown, Kent—Velocipedes
364 G. W. Wigner, Saint Swithin's Lane—Treating and purifying sewage
365 E. Krüger, Portobello, Midlothian, N.B.—Re-utilizing caustic soda lye
366 R. Edwards, Ashford—Steam cultivation
367 A. Luć, Milan—Rendering fabrics waterproof, and a composition to he used for this purpose
368 A. A. Common, Regent's Park—Regulating the supply of water to waterclosets
369 J. Pinney, Bedford—Organs
370 W. Davison, Southwick, and W. Richards, Monkwearmouth, Durham—Composition for preventing the fouling of ships' bottoms, and for preserving surfaces

*9th February* 1870.

371 A. B. Childs, Mark Lane—Machinery for cleaning, scouring, and decorticating wheat and other kind of grain, and also for hulling, cleaning, and polishing rice
372 R. C. Cutting Liverpool, Lancaster, and A. Mason, Boston, U.S.—Compasses
373 T. A. Warrington, Kentish Town—Copying presses
374 J. Tenwick, Grantham, Lincoln—Fingers used in reaping or mowing machines
375 C. Crossley and R. Whipp, Manchester, Lancaster, T. Crossley, Rochdale—Manufacture of size, and the application of a certain material for conditioning cotton and other fibrous substances
376 C. Bardy, Paris—Preparing and obtaiuing colouring matters
377 R. Peacock, Goole, York, and E. Wilson, Peckham, Surrey—Crushing and disintegrating machine or mill
378 J. Haley, Battersea—An illuminated rotary advertising apparatus
379 R. Punshon, Newcastle-on-Tyne—Davits for securing boats on ships' decks at sea without lashing
380 J. T. Greenfield, Dover—Side-arm for clearing the chambers and rifling of ordnance
381 F. Prince, the younger, Plumstead, Kent—Mechanical arrangements to be adapted to the rails of lines of railways, and used in combination with fixed railway signals for preventing such siguals being passed in dark or foggy weather, or otherwise, without the knowledge of the engine-driver or guard in charge of the train
382 T. J. Smith, Fleet Street—Controlling and guiding the movements of torpedo-boats, rams, and other similar vessels—A com.
383 A. and H. Foley, Salisbury, Wilts—Production of photographic pictures or designs on veneers and solid wood, and the application thereof to cabinet work, furniture, fancy wood articles, and other decorative purposes
384 W. Bevitt and T. Strickland, Romford, Essex—Brakes for carriages
385 C. Baylis, Poultry—Preventing impersonation
386 J. Petrie, jun., Rochdale, Lancaster—Machinery or apparatus for washing or scouring and drying wool and other fibrous materials and yarns or threads
387 J. M. Stanley and W. Atkins, Sheffield, York—Fire-places for generating steam, and in other furnaces where great heat is required

10th *February* 1870.

388 H. T. Humphreys, West Limerick, Ireland, and Westbourne Park Road—Railways and rolling stock
389 C. Pontifex, F. Pontifex, and A. Sherwood, King's Cross—Pressing spent hops, grains, beetroot, or other substances used in the processes of brewing and distilling, to extract liquor or moisture therefrom
390 W. Hadfield, Manchester, Lancaster—Looms
391 G. Eguillon, Paris—Reducing the friction of pivots turning on oscillating levers, which system is also applicable to wheeled vehicles, especially wagons or railway trucks—(Com. spec.)
392 W. Honghton. Gomersall, and J. Bapty, Leeds—Dressing warps of wool or other fibrous substances and twine
393 J. Thomson and W. Thomson, Peckham—Ventilation of chimneys and apartments
394 J. C. Wilson, Gracechurch Street—Shearing and washing sheep or other animals
395 W. R. Lake, Southampton Buildings—Apparatus for producing fringe upon woven fabrics—A com.
396 W. E. Gedge, Wellington Street—Currying leather.—A com.
397 W. R. Lake, Southampton Buildiugs—Printing machines, more especially designed for printing cards—A com.
398 W. McG. Mason and T. Lockerbie, Glasgow—Utilising water pressure in raising liquids and in apparatus therefor, also in pressure-reducing valves for the said apparatus
399 W. Swain, Halifax—A cricketer's battery
400 F. T. Ferguson, Boston, Massachusetts—Jug or piteher
401 W. R. Lake, Southampton Buildings—Looms—A com.
402 A. Turner, Leicester—Manufacture of carpets and in the machinery employed therein

11*th February* 1870.

403 J. Imray, Westminster—Subaqueous communication
404 M. Macdermot, Kensington, and A. D. Williams, Westminster—Manufacture of twisted metal bars to form augers and drills, and an improved composite machine for twisting such augers and drills for screw cutting, and for cutting metal rods, bars, and tubes.—A com.
405 D. Dalgleish, Glasgow—Looms
406 A. B. Brown, Woolwich, Kent—Transporting heavy objects
407 W. R. Lake, Southampton Buildings—Spring seats and bed bottoms.—A com.
408 J. Thompson, Bradford, York—Spindle for door handles
409 J. Story, Paris, Kentucky, U.S.—Constructing submarine telegraph cables for the support of insulated conductors
410 E. Stott, A. Ogden, and W. C. Stafford, Ashton-under-Lyne, Lancaster—Clearers applicable to machinery used in the preparation of cotton
411 J. Smart, Stratford, Essex—Slide valves
412 J. W. Dixon, jun. and J. Bates, Sheffield—Machinery for filing
413 I. Nasch, Berlin, Prussia, and C. Grimme, Brunswick—Improvements in sewing machines to produce over-cast and button-hole hems hy means of one single needle
414 R. Chanony, Paris, France—Playing cards.—(Com. spec.)
415 W. R. Lake, Southampton Buildings—Apparatus for drying sugar.—A com.
416 W. E. Newton, Chancery Lane—Machinery for bolting or sifting flour, &c.—A com.

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